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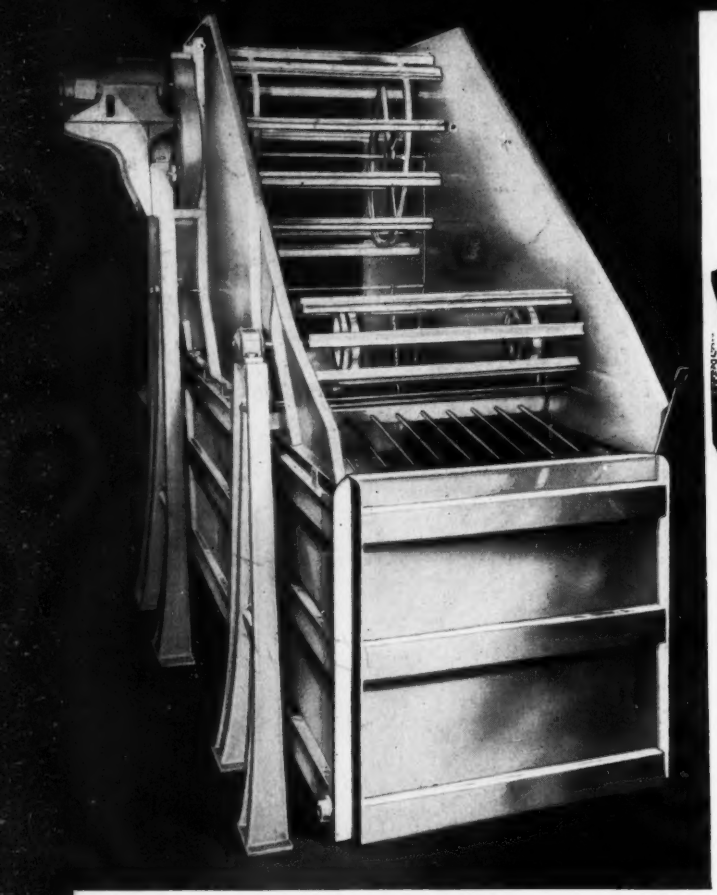

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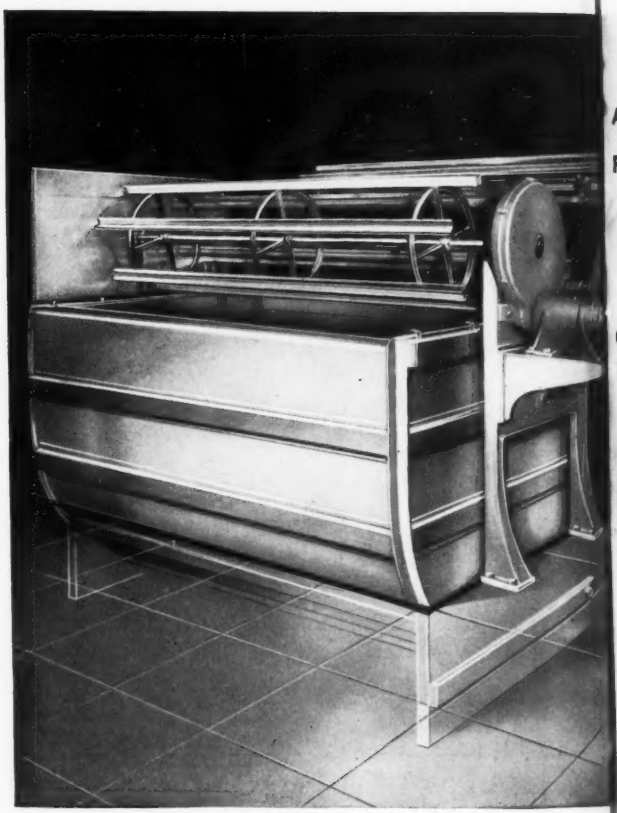

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THE OBJECTS OF THIS ASSOCIATION ARE:

"To promote increase of knowledge of the application of dyes and chemicals in the Textile Industry.

"To encourage in any practicable way research work on chemical processes and materials of importance to the Textile Industry.

"To establish for the members channels by which the interchange of professional knowledge among them may be increased."

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DYESTUFF REPORTER

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Aniline Black

GEORGE A. MORAN*

ANILINE BLACK is the most important black used in the printing of cotton and it has also been quite universally accepted as the black for the printing of the newer and increasingly popular rayons. Due to its low cost, excellent fastness to light and hard soaping, and the richness of shade obtainable therewith, Aniline Black is invariably used wherever the character of the plant equipment and the nature of the associated colors permit.

Chemically, Aniline Black is classed as an "oxidation dyestuff"; that is, the color is actually produced on the fiber by subjecting fabrics, impregnated with chemicals which themselves have little or no tinctorial value to oxidation processes, thereby developing a firmly adherent color of high tinctorial strength. So much has been written on its constitution, and the information so generally distributed, it appears unnecessary to discuss its constitution further here.

Aniline Black is never used for greys on any type of fabric as in such weight of shade its tone is not desirable nor its fastness properties sufficient. Neither is it adaptable for the production of blacks on sheer low count fabrics, where a strength loss of 20 per cent would render them useless for service demands. Its place is in a wide range of medium to heavy weight cloths, capable of withstanding the slight weakening effect of its development on the fiber and on these it may be dyed, padded, printed, and utilized in a wide range of resist effects. Such fabrics may be bleached or unbleached, or mercerized and for certain styles even unscoured.

A great advantage of Aniline Black is its adaptability for printing in a wide variety of styles in combination with vat dyestuffs, with rapid fasts, or with steam colors that are developed by aging only; with such as, Calcochrome Printing Yellow R (C.I. 441), Aniline Black may be used satisfactorily.

The important point in its application is to protect the aniline salt until development by oxidation has taken place, otherwise, no Aniline Black is produced.. With the steam colors employed, an adequate acid condition and suitable atmosphere exist at all times.

In the case of alkaline pastes such as vat dyestuffs and rapid fasts, the alkalinity must be controlled if satisfactory results are to be obtained.

Care should be taken in the drawing of the design and the engraving to see that the alkaline color pastes do not at any time have an opportunity to come in contact with the Aniline Black containing paste. It is common practice to only use Aniline Black in conjunction with vats and rapid fasts in those patterns which have white grounds between the Aniline Black and the other dyes, so that at no time do the colors contact. In the printing machine it is further customary to insure additional protection by running a gum roller between them, or running the Aniline Black ahead of the other colors. Such precautions eliminate "halo" formation and improper development.

Whenever the black of the pattern touches the other colors, it is imperative to use Vat Printing Black to the entire exclusion of Aniline Black.

Aniline Black is not as fast to strong chemic or bleaching solutions, as the better types of vat dyes. However, it possesses sufficient fastness to be satisfactory for most printing uses. It is fully equal in this respect to some vat dyes such as the indigoid type of vat blues.

The printing of acetate rayons with Aniline Black has been tried by many without success. It is extremely doubtful if it will ever be utilized and our recommendation is to employ the more costly related product Amido or Diphenyl Black, which yields equally pleasing shades. Aniline Black does not develop on wool.

From economy standpoints, larger scale users of Aniline Black prefer to make their own hydrochloride from aniline oil. Its conversion is simple once the proper equipment with cooling arrangement is available and competent operators are in attendance. Otherwise aniline salt is convenient, quick and insures uniformity and purity of the necessary 16° tw. liquor generally employed.

Aniline Black having found wide use for more than a half century, a wide range of formulations for general application is to be expected. Practically every operator has his own modified procedure formulated to meet his individual needs. Slight changes in the cloth styles necessitate changes in the composition of the pad liquor to pro-

*Technical Service Division, The Calco Chemical Company, Inc.

duce the shade desired. A shift from one grade of print cloth to another usually requires changes in the proportions of ingredients. In the past it was common practice for plants specializing in Aniline Blacks to run side by side three types such as Prussiate, Copper Sulfate, and Copper Nitrate formulae to meet trade demands.

Of the multitude of formulations the Prussiate Black made with yellow prussiate of soda has been most universally used, having been found to be most effective in reducing tendering of the goods, seldom showing a strength loss greater than 20 per cent to 25 per cent. On the dry cans Prussiate Black develops to a light greenish color and subsequently comes from the ager as a dark greenish black. Soaping produces a blue black, chroming a dense-black shade.

In printing, Prussiate Black is recommended, particularly in conjunction with vat dyestuffs, as it withstands the longer aging better and is benefitted by the afterchroming and soaping essential for the handling of the vats. Also Prussiate Blacks being less acidic than other formulations, minimize the electrolytic effect on the doctor blade and runs of 10,000 yards may be made without "filling up" the doctors. For black and white resist effects, Prussiate Black is invariably used.

Vanadate Blacks, prepared with vanadium chloride or vanadate of ammonia, were used to a moderate extent. They tender badly, oxidize rapidly in the printing paste, and for this latter reason must be used immediately after adding the vanadate to the paste. Blacks oxidized before being printed do not penetrate or fix and will wash off in the soaping, leaving the print threadbare. At present vanadate is rarely used.

As a matter of casual interest, 1 part of vanadium chloride is suitable to catalyze the oxidation of 60,000 parts of print color. Such a solution is prepared as follows:

Formula for Vanadium Chloride Solution (1-1000)

10 grams vanadate of ammonia
7 grams glycerine
70 cc. hydrochloric acid 32° Tw.
300 cc. water

Heat until color of solution has become pure blue and reduction is complete. Make up to 10,000 cc. volume. Add 150 cc. of above to 10 gallon tub of Aniline Black.

Chromate of lead, or "Schmedlin black," was once a most popular type, being well suited for "Silver Greys." This type of print, on account of the fine spatter effects, was quite susceptible to greening and required sharp printing and "non-greening." Schmedlin Black excelled in these two features but has been superseded almost entirely by the Prussiate aniline blacks. In keeping qualities it was one of the best of the aniline blacks, being developed by a moderate baking on the hot cans until a black coloration appeared. Schmedlin Black tenders more than Prussiate Black.

Copper Sulfide Black is another Aniline Black of some importance for printing and serves similar purposes as chromate of lead black. It never attained a large usage as it does not have as smooth working properties and weakens more than Prussiate Blacks. It does, however, yield a black of good keeping qualities and of a dense ungreenable nature.

From a dyeing standpoint, Copper Blacks have always been important competitors with the popular Prussiate blacks during the past quarter century. They first began to attract attention about 1900 and soon developed into a most important factor in the dyeing of solid shades of black on cotton piece goods. The dense, ungreenable shade of low cost made them particularly satisfactory for umbrella cloths, linings, and other similar cloths where exceptionally good quality blacks were required. They are not adapted for the black and white or black and color resist styles. Copper nitrate gives a better black but copper sulfate, being cheaper, is sometimes used.

Tartrate Blacks are theoretically possible, but have never found practical use in America.

Non-greening blacks may be produced by all methods and all have as an objective the further oxidation of the greenable form known as "Emeraldine." Longer steaming and an excess of aniline oil are contributing factors in its production. Sodium bichromate aftertreatment is of further assistance.

While generalities, such as the foregoing, are of moderate interest, the operating man is usually more interested in specific formulae for practical application. To satisfy his needs we are pleased to give a few formulae that have stood the test of time in actual commercial production. These will be presented by the fields covered in the order of dyeing, printing and various modified combination blacks.

For dyeing, a range is required, consisting of a padder, dry cans, and aging box.

To properly dispose of the fumes generated in the process of drying and aging this equipment is usually located in a specially well ventilated room.

As stated previously, economical production of Aniline Black on a large scale necessitates local production of muriate of aniline in 16° Tw. solution. Prepare in adequately cooled apparatus a mixture of the following proportions:

275 lbs. aniline oil
300 lbs. muriatic acid 32° Tw.
355 lbs. water

930 lbs. 110 gallons @ 16° Tw.

The amount of aniline oil specified is about 10 per cent in excess of theoretical and is desirable for the best results in developing an ungreenable Aniline Black.

Any quantity desired may be made up. A wooden tank of suitable size is used. This is provided with a hood and draft to carry away the fumes. The acid is reduced in strength to 14° Tw. with water. This can be done in a barrel provided with a stoneware faucet which delivers the 14° acid through a lead pipe to the oil. The lead pipe extends below the surface of the aniline oil to reduce the fumes evolved. After adding the acid the solution is allowed to stand for some time until cooled off, and is then

brought to 16° Tw. or such other strength as desired. Before bringing to strength, the solution should be tested for neutrality with a very weak solution of Methyl Violet. If on the oil side the dyestuff solution will remain red violet; if strictly neutral it will turn blue; while if on the acid side it will turn green. It is usually desirable to have the solution on the oil side. After testing, more oil or more acid may be added to bring the solution to whatever condition is desired. For best results either for printing or dyeing, a 10 per cent excess of oil is desirable to insure a non-greening black after oxidation.

The most widely dyed Aniline Blacks are of the Prussiate type and properly operated conform to the three essentials:

1. Non-greenable
2. Minimum tendering of the fabric
3. Deep pleasing tone of shade

Pad Liquor	*Solid Blacks Unmercerized*	*Solid Blacks Mercerized*
Muriate of aniline 16° Tw.	20 gallons	20 gallons
Prussiate liquor	44 gallons	37 gallons
Acetic acid 56%	½ gallon	½ gallon
Aniline oil	1 gallon	1 gallon
Gum tragacanth—6 ozs.	2½ gallons	2½ gallons
Water	32 gallons	39 gallons
	100 gallons	100 gallons

Prussiate Liquor

80 lbs. sodium chlorate
140 lbs. sodium yellow prussiate
50 gals. water
Bulk to 100 gallons

Run the cloth through the pad liquor, then through the squeeze rolls, and directly on to the dry cans.

For heavier cloths or unscoured or only partially scoured cloths a double dip and double squeeze or even more may be required to insure penetration and the depth of shade desired. A three bowl mangle is used for the purpose, or two padders may be used. For deeper blacks of greater solidity, a double dip is preferable.

Scouring and bleaching should be carried only to the point where sufficient absorbency to wet out readily is attained, and maximum strength preserved. Mercerized fabrics require about 10 per cent weaker pad liquors than unmercerized.

After padding, the goods are dried on dry cans and should come off slightly greenish in shade, and after running in the rapid aniline ager for one minute they should come out a green black. Passage through hot soda ash solution to neutralize the acidity, together with hot sodium dichromate to develop the oxidation to the ungreenable black, and a good soaping completes the processing. Common practice is to utilize the open range, but a rope soaper is more thorough in washing effectively.

Black and white resists employ a thinner liquor:

Muriate of Aniline 16° Tw.	12 gallons
Prussiate Liquor	30 gallons
Acetic Acid 56 per cent	½ gallon
Aniline Oil	½ gallon
Gum tragacanth 6 oz.	18 gallons
Water	39 gallons
	100 gallons

and are run face up through the nip only in order to preserve the whites as much as possible. A full bleached cloth is best employed for this style as the cloth is more absorbent and the liquor is taken up more readily.

White resists are not run through chrome as this treatment tends to yellow the whites. Soap converts the green black to a denser or bluer black which while not ungreenable, does meet trade requirements.

Copper Blacks give the densest and most ungreenable shades and can be produced with a minimum of tendering. The plant required differs from that used for Prussiate Black. It requires a pad box with a three bowl padder for double immersion and a small stack of dry cans for partly drying the goods. The goods almost but not quite dry, pass directly into an aging chamber which is heated with steam coils to a maximum of 180° F. dry temperature. Ventilation is provided for removing moisture as it accumulates while the cloth is passing through and the moisture left in the cloth from the dry cans dries out. The aging chamber is large enough to give from 3 to 7 minutes aging according to the character and weight of the goods being run. Heavy goods require a longer drying on dry cans and a longer period of aging to dry out the residual moisture and develop the black. On coming off the dry cans the goods are greenish yellow and slightly damp. The color of the goods develops, during the passage through the ager, to a full dense black as they come out. After coming out they can be run direct through an open washer and if necessary chromed, according to shade desired. Chroming reddens the black. If sufficiently red in shade, the chroming may be omitted or reduced.

Formulae

Aniline Oil	68 lbs.
Acetic Acid 56%	95 lbs.
Water	205 lbs.
Nitric Acid 36° Bé	16 lbs.
Water to make—50 gallons	
Copper Nitrate Cry.	50 lbs.
Sodium Chlorate Cry.	33 lbs.
Water	35 gals.
Make up to —50 gallons	

Mix in equal proportions just before use. This mixture possesses good keeping qualities. It stands at 14° Tw. and the strength can be varied up or down, according to the character and condition of the fabric. For re-dyes, about ¾ of above strength should be used. After chroming, soap at 160° through soap and soda ash, rinse and dry.

Copper Sulfate Black is sometimes substituted as a cheaper black than the nitrate. A typical formula is as follows:

"A"—Muriate of Aniline Solution 14° Tw.

"B"—Copper Chlorate Solution 32° Tw.

Copper sulfate crystals	101 lbs.
Sodium chlorate	134 lbs.
Water	660 lbs.
	895 lbs.

"C"—25 lbs. Sodium Bichromate dissolved in 100 gals. water.

Pad the goods through preferably three or four roll pads with a freshly prepared mixture of:

20 gallons "A"
10 gallons "B"

Dilute with water to yield 9° Tw.—12° Tw. depending on the character of the goods treated. Squeeze evenly with a tight set and partially dry over a short tier of dry cans. Careful supervision is essential at this point, as on leaving the dry cans the goods must contain some moisture and show a mottled green and grey appearance—not a full green or black. Then pass directly to an ager where a moist atmosphere at about 180° F. is maintained by a steam spray, for a one minute run, at the conclusion of which they should have an even dark green appearance. Sky for about a 50 ft. run in the open air and pass through a mangle containing Solution "C". Plate into slatted boxes and lay 30 minutes. Run a second time in Solution "C" and lay one hour. Then rinse, neutralize with soda ash, rinse and dry.

Typical print formulae for cotton, rayon or pigmented rayon follow. Some adjustments may be advisable, depending upon the type of cloth and the equipment available for processing. On the average for the types of black concerned, they are illustrative.

Prussiate Aniline Black

"A"—Muriate of aniline paste

32 gals. water
50 lbs. cornstarch
20 gals. muriate of aniline 16° Tw. Sol.*
Boil up in a steam jacketed copper kettle, cool and add:
3 pints Calcozine Violet Ex. (C.I. 680) (4 oz. solution)

50 gallons bulk.

"B"—Yellow Prussiate Paste

40 gals. water
60 lbs. cornstarch
30 lbs. British gum
½ lb. stearic acid
Boil up in a steam jacketed copper kettle and add:
35 lbs. sodium chlorate
70 lbs. sodium yellow prussiate
1 gal. corn oil
Cool and bulk to 50 gallons

Mix "A" and "B" in equal proportions and add such quantities of reduction paste as may be desired. Print, dry moderately on dry cans, age one minute in the rapid aniline ager, or four minutes in the vat ager if printed along with vats. Oxidize by a passage through chrome and acetic acid as for a vat color. Rinse, soap and dry.

In recent years the use of a "nitro acetate of aniline solution" in place of the muriate has increased to a considerable extent due to the fact that Aniline Black is now so frequently printed in patterns alongside of vat dyes which require 4 to 6 minutes ageing. The "nitro acetate black" shows less tendering of the fabric under these conditions and consequently is the most satisfactory black for such use.

The following formula has been found in practice to give excellent results both as to shade and in preserving the strength of the fabric:

Nitro Acetate of Aniline Black, Salt Solution

9 gals. aniline oil
5½ gals. acetic acid 56%
6 gals. nitric acid 36° Bé.

This salt solution should be made under a hood provided with good ventilation and it is advisable to use a cooling system.

Prussiate Paste

32 gals. water
40 lbs. cornstarch
25 lbs. tapioca flour
Boil up in steam jacketed copper kettle and add:
70 lbs. sodium yellow prussiate
35 lbs. sodium chlorate
Stir till dissolved, cool and make up with water to 50 gallons

Black Print Color

8½ gals. prussiate paste
3½ gals. salt solution
2 gals. starch paste
2 gals. British gum

16 gals. bulk

This color can be reduced 5 to 1 with reduction thickening or otherwise as desired, according to the character of the design. Instead of making the salt solution separately, the various ingredients may be added successively to the Prussiate Paste, first the aniline oil, then the acetic acid, and finally the nitric acid, stirring each in completely before the next addition.

Chromate of Lead Black

"A"—30 gals. water
18 lbs. cornstarch
18 lbs. wheat starch
25 lbs. British gum
½ lb. stearic acid
½ gal. acetic acid 56%
Boil in steam jacketed copper kettle, partially cool and add: 60 lbs. chlorate of soda, dissolved in
8 gals. water. Strain, cool and add:
32 lbs. yellow chromate of lead pigment (40%)
½ lb. yellow prussiate of soda
Bulk to 50 gallons

*70 lbs. aniline salt dissolved in 15 gallons of water, may be substituted.

"B"—10 gals. water
65 lbs. cornstarch
40 gals. muriate of aniline 16° Tw.*
¾ gals. aniline oil
Bulk to 50 gallons

For Printing Mix:
2 gallons "A"
1 gallon "B"
2 gallons reduction paste

5 gallons

Print, dry to a black on the cans, age 1 minute in the Rapid Aniline Ager. Rinse, soap and dry.

Omit chroming treatment as the Lead Chromate oxidizes adequately. This black is somewhat dull by comparison with other aniline blacks, owing to the large amount of Lead Chromate pigment present. It needs to be dried hard on the dry cans and should develop black at that stage before aging.

Copper Black

Use the same type of formula as for Chromate of Lead, substituting copper sulfide paste for chromate of lead paste.

A considerable amount of Aniline Black work requires a white or colored resist. Various resists are printed usually on full bleached white cotton cloth. After drying, the cloth is set aside until sufficient has accumulated to run off as a special run in a weaker depth of shade of black than is commonly produced. Details were discussed earlier in this article:

For White Resist:

"A"—Hypo gum
15 gallons water
200 lbs. sodium thiosulfate
Heat to dissolve, and add:
100 lbs. British gum
Cool and bulk to 45 gallons

"B"—Zinc oxide paste	6 lbs.	10 lbs.
Zinc oxide	300 lbs.	500 lbs.
Gum tragacanth paste thin	35 gals.	35 gals.
Glycerine	1½ gals.	1½ gals.

Grind thoroughly in cone mill and bulk to 50 gallons

Mix 5 gallons "A"
6 gallons "B" (6 lbs.)

Print and dry over moderately hot cans.

For colored resist work the Calcozine or basic dyestuffs are utilized.

"A"—Resist White
10 gals. zinc oxide paste—(10 lbs.)
10 gals. wheat starch paste
5 gals. British gum thickening (3 lbs.)
15 gals. gum tragacanth paste
2½ gals. sodium bisulfite 60° Tw.
½ gal. turpentine
Let stand one hour, then add
36 lbs. acetate of soda
Bulk to 45 gallons.

"B"—
4 gals. alcohol
4 gals. glycerine
4 gals. water
4 lbs. Calcozine Yellow T (C. I. 815)
2 lbs. Calcozine Blue G (C. I. 922)
Bulk to 14 gallons.

Mix 1 gallon "B" to 5 gallons "A" and print as for white resist. Brilliant colored effects are obtainable with the wide range of basics available.

Vat color resists under Aniline Black are being used increasingly. Print any desired shade and strength of vat printing paste to which has been added 1 gallon of 6 lbs. zinc oxide paste per 6 gallons of printing color. Dry and age as usual in the vat ager, then pad with Aniline Black padding solution as for black and white resists. To preserve the outlines completely, the Aniline Black pad liquor should be thickened with a little cornstarch. Pass through the aniline ager for one minute, then through the chrome and acetic, rinse, soap, and dry. Very satisfactory shades of the proper brightness and fastness are obtained.

Vat colored resists give full brilliant and fast shades but require considerable care for their successful application. For fine details a large amount of zinc oxide should be used to preserve the shapes and prevent haloes, and the ageing conditions for the printed vats should be moderately dry for the same reason, as, otherwise, the alkali in the vat prints tends to run a little. For black figures less zinc oxide is needed. Pad in the aniline black liquor through the nip, printed side up.

Rapid Fast and Rapidogen dyes give excellent results as resists under Aniline Black dyed ground. They are useful principally for the full brilliant shades. The light shades and shades not obtainable with Rapidogens may be developed from Indigosols or vats. The Rapid Fasts or Rapidogens are made up as usual. To 6 gallons of print color, add 1 gallon, 6 lbs. milled white as follows:

6 lbs. Rapid Orange GNR Paste
¾ gal. Cellosolve
¼ gal. caustic soda 30° Bé.
2 gals. water
10 gals. starch tragacanth paste
2 gals. 6 lbs. milled white

15 gallons bulk

After printing, dry moderately and take directly to the black padder and run through the nip printed side down. Use the same black pad liquor as for black and white discharge styles, but add, per 100 gallons of pad liquor, 1 gal. of 85 per cent formic acid and 2 gals. of 50 per cent acetic acid in place of an equal amount of water. Dry well on the dry cans. This develops the Rapidfast and Rapidogen dyes. Age 2 to 3 minutes in the rapid ager. Chrome and soap as usual in the open soaper.

Processors of Aniline Black White ground prints at times require a means of clearing the white of fine streaks or "scums." A satisfactory procedure is to oxidize with

*140 lbs. aniline salt dissolved in 30 gals. of water, may be substituted.

potassium permanganate. Dissolve ½ lb. of potassium permanganate in 50 gallons water, pad the goods with a concentration as preliminary test indicates is effective; squeeze and run over a set of dry cans. The goods come off brownish in color and are run in open width through an open soaper, the first box of which contains 3 lbs. oxalic acid per 50 gallons of water at 160° to 180° F. The remaining boxes contain rinse water and soap.

There are many more variations of process to produce Aniline Black, all having the purpose of reducing cost or eliminating tendering. With formulae of the type mentioned, a processor can secure satisfactory results with the proper apparatus under the guidance of trained operators. When well applied, Aniline Black will hold its own against all other blacks and we predict it will be many a year before we find this time tested black eliminated in the "pitching" of print patterns.

Physical and Chemical Textile Testing-VIII

JOHN H. SKINKLE*

PART I—PHYSICAL TESTING

(Continued from March 21, 1938, issue)

Chapter 8—Strength and Stretch Testing of Fibers, Yarns and Fabrics *(Continued)*

THE stretch of a textile specimen is most accurately determined by an autographic recorder mechanism as described in a previous paragraph. This consists of a pen moved horizontally by attachment to the pendulum and a platform holding the paper moved vertically by the lower jaw of the strength machine. A little consideration will show, however, that the vertical motion of the lower jaw is not only the stretch of the specimen but also includes the motion of the upper jaw, since the upper jaw moves downward a small amount for any motion of the pendulum. In Figure 42a the line OA represents the autographic record of a break on a cotton yarn but the ordinates of this yarn are not stretch alone but also include the motion of the upper jaw. If a piece of rigid material such as steel is clamped between the jaws, so that the motions of the upper and lower jaws are the same, the line OB will be drawn which gives us the motion of the upper jaw for various loads. The true stretch of the cotton yarn, then, is the difference between the ordinates of OA and OB. In order to correct for this automatically, modern stretch recorders are made so that the pen moves on a downward sloping guide at the same angle downward as the angle BOX. The same cotton yarn run in this manner is shown in Figure 42b in which the horizontal line is now the motion of the upper jaw; the ordinates of the line OA (above the horizontal) now represent stretch alone. On stretch-load diagrams following this, it is assumed that this correction is made and that the ordinates represent stretch alone.

Where total stretch is the only quantity desired, it may be obtained by fastening a spring tape to the bottom jaw of the machine and having it unroll past an index on the top jaw. A snap reading of the tape is taken just as the sample breaks and this gives us total stretch or "stretch at the break." Stretch charts, however, are much more preferable as giving more information about the sample; stretch charts will tell us:

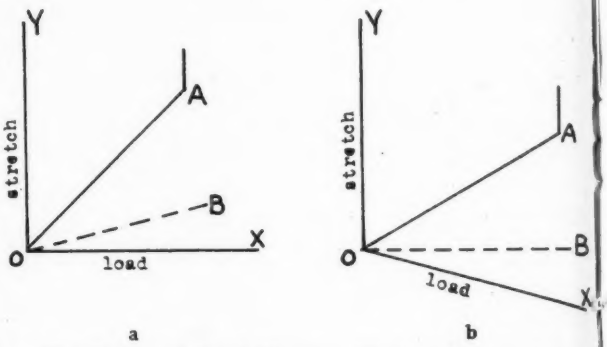


Fig. 42—Stretch-Load Diagrams, Motion of Upper Jaw

1. The total stretch of the sample.
2. The manner of breaking, whether abrupt or prolonged.
3. The elastic limit, if any.
4. The area under the curve may be measured, this gives us the work necessary to break the sample, which in turn is a measure of the toughness of the sample.

If any sample is put loosely into the jaws of the machine, there will be a certain initial motion of the lower jaws, when the slack of the specimen is taken up, before any load is applied to the sample; this reading should be deducted from any stretch readings (Figure 43a). If the sample is placed in the jaws under a small initial load which is enough to straighten but not to stretch the sample, this initial period is absent and the diagram gives stretch directly (Figure 43b). The initial tension in the case of fabrics is specified by the A.S.T.M. as 6 ounces. Diagrams given after this will assume that this slack has been corrected for or eliminated by this initial tension.

Figure 44 gives typical but somewhat idealized stretch-load diagrams of the different types of yarns, idealized only in the sense that small fluctuations have been smoothed out on the curve. Figure 44a shows that yarns made up

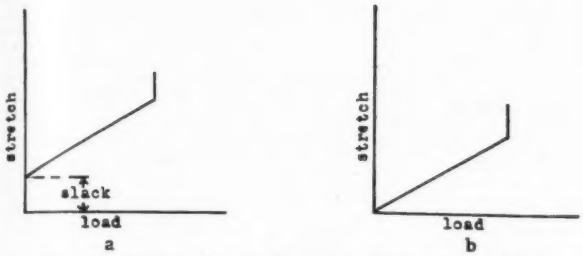


Fig. 43—Stretch Load Diagrams, Slack of Specimen

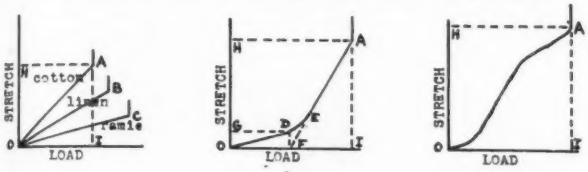


Fig. 44—Typical Stretch-Load Diagrams of Yarns

of the natural vegetable fibers give a stretch which is directly proportional to the load applied up to the breaking point (A, B. C). If we take the case of cotton, the breaking strength is OI and the total stretch is OH; the slope of the curve (OH/OI) is the stretch per unit load and has been found to be dependent principally on the material in the yarn and treatments which change this material change the slope; thus it is possible to use this slope to determine whether a given chemical treatment which might not have affected the strength has altered the material.

Figure 44b for rayons and silks shows a different type of diagram. In this diagram, we have first a portion OD which is a straight line representing the elastic stretch; at D, elongation or plastic flow begins; at point E the elastic stretch is completed and only elongation is left up to the point A where the yarn breaks. If the line AE is continued to the point of zero stretch (F), we have the load (OF) at which the yarn would begin to flow if it had no elasticity; this load (the yield point) should theoretically be the same load as that at the point D where the elongation begins (GD), this is usually true but sometimes the two loads are not exactly the same. To sum up, the following information may be determined from this diagram:

Loads (usually expressed in grams per denier)

Breaking strength	= OI
Yield point	= OF
Elastic limit	= GD

These last two should be equal.

Stretch measurements (usually expressed as per cent of the gauge length)

Total stretch	= OH
Elasticity	= OG
Elongation	= GH

Wet rayon does not give this type of curve but a single straight line with a steep slope.

Figure 44c shows a typical curve for a woolen or worsted yarn. This type of yarn has been less thoroughly studied so we cannot draw as much information from it. It will be noted, however, that this diagram starts off similar to the rayons and silk but that above a certain load a further change in the curve appears. This second change may be due to a change in the molecular structure of the wool. In the case of all the yarns, the area between the curve OA and the load axis gives a measure of the work done in breaking the sample and hence the toughness of the yarn.

A cloth made of a certain type of yarn shows the stretch diagram of that yarn with the addition of an initial curved portion which represents the straightening of the vertical yarns due to removal of crimp. Figure 45 shows a stretch-load diagram of cotton cloth in which we have the straight line of cotton yarn superimposed on this initial curve. In this curve,

Breaking strength	= OI
Total stretch	= OH
Crimp	= OJ

This diagram gives us, then, a rather rough determination of crimp in addition to the strength and stretch data. This method of determining crimp is not as accurate as the method described in Chapter 5 because of the small size of the curve from which the measurements must be taken. As in the case of yarn, the area under the curve gives us the work required to break the sample; and the slope of the straight line portion of the curve (JH/OI) gives us information as to changes in the material of the fabric. Rayon and woolen cloths would give stretch-load diagrams similar to the corresponding yarns but with the crimp curve added.

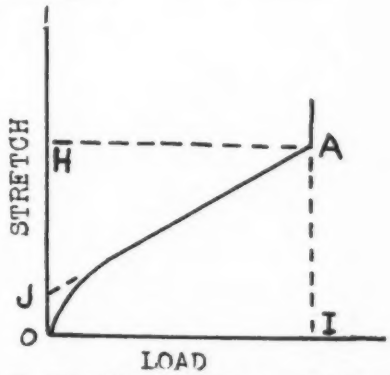


Fig. 45—Stretch-Load Diagram of Cotton Cloth

CONSTANT RATE-OF-LOAD MACHINE

We have seen in the preceding section that, on a pendulum type strength machine, the apparent strength of a sample varies with the size of the machine, the amount of stretch of the sample, the length of the specimen, and the speed of the lower jaw; all these variables affect the final result by affecting the rate of loading of the specimen. If a constant rate of load machine is used, it is found that the following advantages result:

1. Rate of load on the specimen is uniform whether the specimen is long or short, rigid or stretchy, strong or weak.

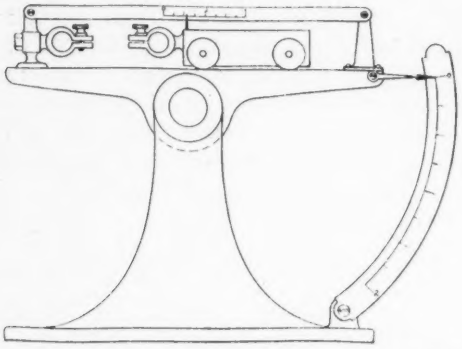
2. One machine may be used for a very great range of yarns and fabrics, because the capacity of the machine has no effect on the result.

3. It makes little difference what rate of load is used; a standard rate may be used but other rates will give results within a few percent of each other.

4. Variations in strength of a single fabric are less than on a pendulum type machine; this means that the average result is more accurate, or on the other hand that fewer tests may be used to get an equally accurate average.

The A.S.T.M. specifies, for rayon yarns tested by the single strand method on a constant rate-of-load machine, 4 grams per denier per minute.

The construction of a constant rate-of-load machine is of the inclined plane type illustrated in principle by Figure 46. As the plane is tilted downward on the right side, the rolling carriage puts more and more load on the specimen in the clamps. In order to get the constant rate of load, the tilting is done by a screw mechanism connected with a constant speed motor (Figure 47). Stretch may be determined from a stretch-load diagram as in the case of the pendulum machine.



Courtesy of Henry L. Scott Co.

Fig. 46—Principle of Inclined Plane Strength Tester

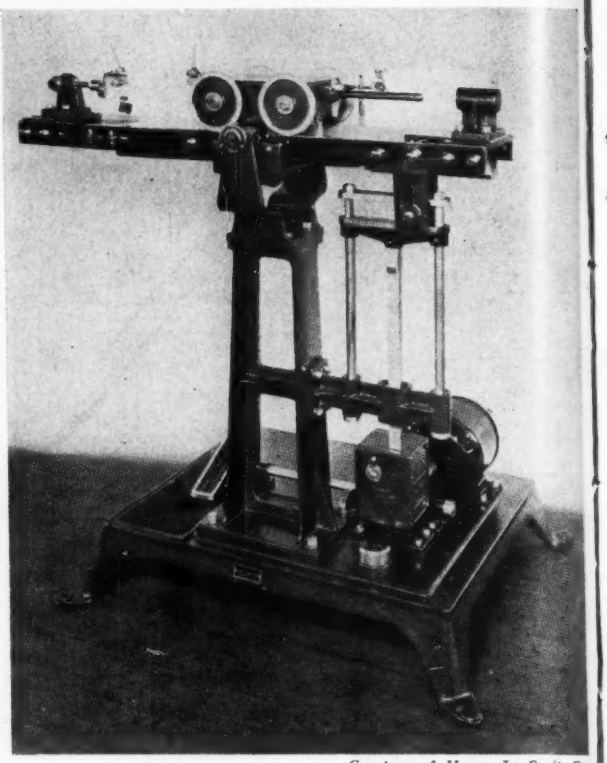
At present, the use of the constant rate-of-load machine is not very general, due principally to the fact that so many machines of the pendulum type were already in use. The advantages of this type of tester have already been given, the disadvantages are:

1. At present a laboratory would have to have both pendulum and inclined plane machine since most specifications and nearly all of the accumulated data are in terms of the pendulum machine.

2. One of the most valuable uses of the strength tester is to show the variation in a sample; the inclined plane type gives less variation in results.

3. The advantage of having one machine to test a wide range of textiles is largely offset by the fact that most plants do not use or make textile yarns or fabrics having such a wide range of strengths, so that a single pendulum machine of double range (with and without the weight on the pendulum) will take care of the whole range of any one plant's products or purchases.

4. Most testing is comparative; that is, one sample is compared with another, so that it does not really matter what type of machine is used.



Courtesy of Henry L. Scott Co.

Fig. 47—Constant Rate-of-Load Strength Machine

In view of these advantages and disadvantages, the future of the inclined plane type of tester is still in the doubtful stage.

BALLISTIC STRENGTH MACHINE

A strength testing machine developed abroad and which has received little attention in this country is the ballistic or impact tester. In principle, this is a pendulum with most of its mass concentrated in the weight, the pendulum is swung from a definite height on one side of an arc and on swinging freely will swing to nearly the same angle on the other side of the arc. The specimen is attached at one end to the weight of the pendulum, and at the other end to a fixed clamp. When the pendulum now swings, it breaks the specimen but is slowed down so that it does not swing so far up the arc. The difference in height of the arcs swung through without a specimen and with a specimen attached is a measure of the energy used in breaking the specimen. This energy is the work of rupture obtained from the stretch-load charts of the pendulum type strength tester.

The work of rupture is a good measure of chemical tendering because, although tendering usually decreases both strength and stretch, sometimes the strength is not affected although the stretch is decreased. Work of rupture is directly proportional to the width of cloth broken

(Continued on page 247)

PROCEEDINGS OF THE

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MAY 2, 1938

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CALENDAR OF COMING EVENTS

Meeting, New York Section, Swiss Chalet, Rochelle Park, N. J., May 20, 1938.

Meeting, Northern New England Section, Andover Country Club, Andover, Mass., May 6, 1938. Speakers: K. H. Barnard, "Permanent Finishes on Textiles"; Hugh Christison, "Olive Oil Substitutes for Worsted Lubrication"; Edward S. Chapin, "Fixing of Dyes Before and After Dyeing"; Alex. Morrison, Subject to be announced later.

Outing, Philadelphia Section, Whitemarsh Valley Country Club, June 10, 1938.

Spring Meeting, Piedmont Section, Greensboro, N. C., May 7, 1938.

Meeting, Mid-West Section, Hotel Schroeder, Milwaukee, Wis., May 7, 1938.

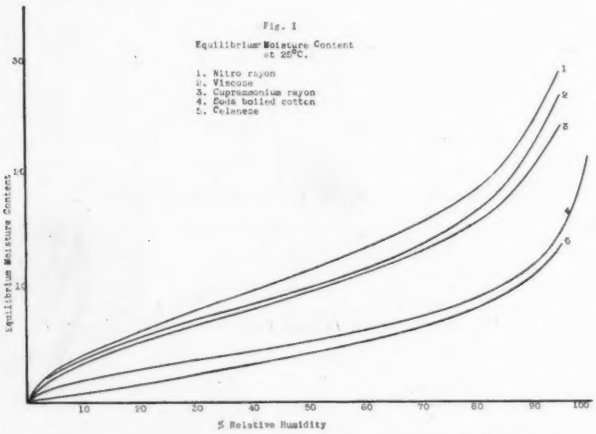
Annual Meeting and Convention, Atlanta Biltmore Hotel, Atlanta, Ga., December 2 and 3, 1938.

Equilibrium Moisture Content

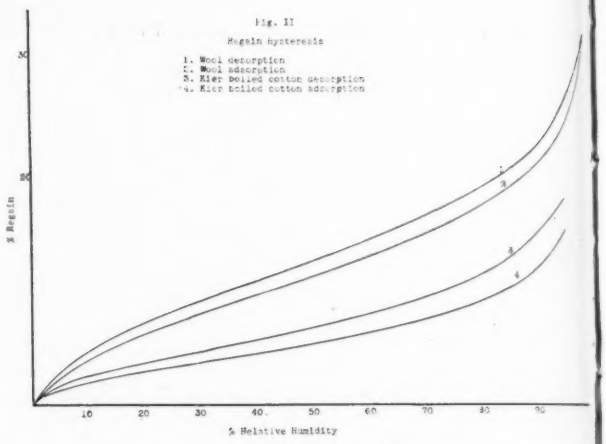
of Some Textile Materials*

E. K. STRACHAN**

IT is quite well known that the equilibrium moisture content, or regain, of textile materials is dependent on the humidity of the air with which they are in equilibrium. The purpose of this discussion is to present some of the knowledge that has been gained on this subject and to draw conclusions from it that have a bearing on the origin of heat in the ager used in vat dye printing on cotton and rayon.



The general nature of the relation between regain and humidity is illustrated in Fig. I. The data from which these curves were plotted were taken from various sources, only a few of the more important of which will be mentioned. The humidity relations of cotton and rayon have been studied extensively by Urquhart and his associates [1, 2, 3, 4, 5, 6, 7, 8, 13]. Wool has been examined by a number of investigators[11, 12], most recently by Speakman and his associates[9, 10]. Many other colloidal materials exhibit the same phenomena, silk, starch, leather, paper, etc. The above examples, however, are adequate to show the general form of the regain curves. In Fig. I the horizontal axis represents the percent humidity, and the vertical axis, the percent moisture on the dry basis when the dry material is allowed to absorb moisture until equilibrium is reached. All of these curves except that for celanese show double inflections. If moist material is allowed to dry the regain does not follow the same curve, but one higher on the chart indicating greater moisture content at the same humidity. This phenomenon is of



value in dealing with wool, since wool that is brought down from a higher humidity to the humidity of the work room contains more moisture than one that is raised from a lower humidity and hence the wool is easier to work since it is more pliable at the higher moisture content. Fig. II exhibits two such hysteresis curves. The location of both adsorption and desorption curves depends on the past history of the material both with regard to its chemical and mechanical treatment and on how dry or wet it was at the beginning of the wetting or drying process. Hence, Urquhart and Eckersall[2] conclude "the absorption and desorption curves are merely the boundaries of an equilibrium area, any point on which may be capable of representing the moisture regain of a sample of cotton under suitable conditions of moisture and prehistory". "A definite curve can, however, be obtained by removing water from cotton containing at least 40 per cent water."

Except for mercerization, the ordinary finishing operations do not affect the regain greatly as can be seen in the figures of Table I.

TABLE I

% Regain

Humidity	*Gray*	*Kier boiled*	*Kier boiled Soured Dried*	*Mercerized*	*Mercerized Soured Dried*
5	1.5	1.3	1.5	1.7	1.7
25	3.5	3.4	3.3	4.1	4.0
50	5.6	5.5	5.4	6.7	6.6
75	8.1	8.5	8.2	10.1	9.8
85	9.9	10.5	10.3	12.4	12.2
95	12.8	15.3	14.1	17.5	17.0

*Presented at meeting, Rhode Island Section, March 25, 1938.
**Brown University; Cooperating Member. Printing Paste Committee.

Temperature affects the equilibrium moisture content as well as the other factors mentioned. Trouton[14] showed that if the heat of evaporation of water from the material is the same as the heat of evaporation of liquid water, the regain, regarded as a function of the humidity, will be independent of the temperature. Experiment shows that the regain curves so plotted vary somewhat with the temperature in the case of a number of materials, but not a great deal. The regain at constant humidity increases somewhat with temperature rise as is shown in Table II.

TABLE II

	Percent Relative Humidity			
T°C.	10	50	80	90
		Regain		
10	2.1	5.5	9.5	12.8
50	1.5	4.7	8.4	11.3
100	0.9	3.5	6.8	11.2

This indicates that the heat of evaporation of water from the goods is somewhat greater than the heat of evaporation of pure water. The difference is equal to the heat of wetting the goods with liquid water.

Shorter[15] computed the heat of wetting cotton, wool and silk with liquid water by use of a modification of the well known Clausius-Clapeyron equation

$$\triangle Q = RT^2 \frac{d\ln H}{dT}$$

in which $\triangle Q$ is the heat of wetting with one mol. of water, R the gas constant in calories per mol. per degree Centigrade, T the absolute temperature and lnH, the natural logarithm of the relative humidity. Similar calculations for cotton made by the author on the basis of the more accurate measurements of Urquhart and his associates yield values not very different from those found by Shorter. The data of Urquhart and Williams[2], while not obtained for this purpose, are admirably consistent and afford a means of calculating the heat of wetting cotton with steam by use of the equation

$$\triangle Q = \frac{RT_1T_2}{T_2-T_1} \Big/ \frac{\ln P_2}{\ln P_1}$$

in which P_1 and P_2 represent the partial pressure of water above cotton containing a constant moisture content, at the temperatures T_1 and T_2, and $\triangle Q$ the heat of wetting with steam. At temperatures between 20° and 60° C. and regains of 1 to 11 per cent concordant values are easily obtained showing that the heat of wetting cotton with steam is somewhat greater than the latent heat of evaporation of water within the same temperature range and amounts to approximately 10,000 to 12,000 calories per mol. of water combining with the cloth. At higher temperatures and higher regains the data are more scanty and less easy to correlate. They indicate, however, a diminution in the heat evolved so that the heat of wetting with liquid water may even be negative in this region. The values range from 8,000 to 10,000 calories per mol. of steam combining with the cloth.

The values of $\triangle Q$ obtained in this way are shown in column 2 of Table III. They represent the heat evolved when one gram molecule of steam is added to an infinite amount of cotton of moisture content $\propto$. The heat of wetting with water, shown in column 3 of the table, may be obtained from these values by deducting from them the molal heat of evaporation of water, which amounts to 10,450 calories in this temperature range. These heats are not exactly the information we want. We desire to know the heat evolved when one gram of cotton of moisture content $\propto$ is completely wetted with steam. The desired values can be obtained from the data of Table III by a simple mathematical process and are exhibited in Table IV. Column 2 shows the number of calories evolved when one mol. of water is added to sufficient cotton to make the moisture content of the mixture the same as the regain shown in column 1. Column 3 and 4 respectively show the number of calories evolved when one gram of cotton is completely wetted with water or steam.

TABLE III

1 *Regain of moisture per gram cotton*	2 *Differential heat of wetting with steam*	3 *Differential heat of wetting with water*
0.012	12898	2446
0.019	12911	2452
0.031	11873	1421
0.038	12175	1723
0.043	11745	1292
0.052	11649	1197
0.061	11279	817
0.072	11334	882
0.087	11018	566
0.115	10721	262

TABLE IV

1 *Regain*	2 *Integral heat of wetting with water*	3 *Heat of complete wetting with water*	4 *Heat of complete wetting with steam*
0.00	...	5.6	178
0.01	78	4.0	171
0.02	138	3.0	165
0.03	184	2.2	158
0.04	218	1.5	151
0.05	245	1.1	145
0.08	291	0.5	127
0.10	306	0.25	116
0.15	327	...	...

These conclusions with respect to the heat evolved on wetting cotton with steam are directly applicable to the much disputed problem of the origin of heat in the ager used in connection with printing vat colors. The mere heating of the goods would be of little consequence were it not for the consequent loss of color value, a fact which seems to be universally conceded.

Mason and Richards[16] found that dry cotton submerged

in moist air at room temperature showed a decided rise of temperature, amounting to as much as 15° C. (27° F.). Temperatures of 240° F. are not uncommon in the ager. Mason and Richards used absorbent cotton, but in our laboratory we find substantially the same temperature rise using bleached cotton cloth. Our figures indicate that if one gram of cotton is completely wetted with steam 178 calories will be evolved, a quantity of heat sufficient to raise the temperature of the goods to about 300° C. if the heat capacity of one gram of cotton and its associated moisture is 0.8 cal. per degree. This, of course, is absurd: no such temperature is encountered. Several circumstances exist to prevent this excessive development of heat. In the first place the cotton entering the ager contains some moisture, secondly, adsorption of moisture requires a measurable time during which the material can radiate a certain amount of heat, and in the third place, as soon as the temperature rises the relative humidity is lowered and the goods will absorb less moisture. This last point is not so apparent as the two preceding ones. Suppose an ager filled with saturated steam at 100° C., 760 mm. pressure. The relative humidity is 100 per cent and the regain about 23 per cent. Now allow the goods to heat, e.g. to 110° C. and raise the temperature of the air to the same figure. The saturated vapor pressure of water at 110° is 1075 mm. and the relative humidity is $\frac{760}{1075} = 70$ per cent. At 110° C. and 70 per cent humidity the regain is only about 5 per cent. If the entering cotton contained 3 per cent regain and the temperature in the ager rose to 110° C., the heat liberated would be about (158-145) = 13 calories per gram of cotton, a substantial reduction in the quantity of heat for which we must account. This specific example, of course, is only illustrative but suffices to demonstrate that the heat of wetting the cotton is ample to account for the temperature rise observed in the ager. It is substantially greater than the heat evolved by the chemical reactions. The fact that printed goods causes a greater rise of temperature than unprinted goods may be attributed principally to the presence of starch which has approximately the same absorptive capacity for water that cotton does. The fact that rayon shows a greater temperature rise than cotton is due to its greater regain.

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MEETING, PHILADELPHIA TEXTILE SCHOOL STUDENT SECTION

ON Friday, February 18, 1938, the Philadelphia Textile School Student Section held its regular meeting, with Chairman Wayne Fry presiding.

Dr. Roy H. Kienle and Dr. George L. Royer, of the Research Department of Calco Chemical Co., Inc., presented two interesting films on "Calcoloid Dyes" and "Metallized Dyes." The films were capably explained by Dr. Kienle and Dr. Royer.

Respectfully submitted,

ROBERT F. ROECKER, *Secretary.*

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Mynhart O. Brueckner—Dyer and Chemist, Chas. H. Bacon Co., Lenoir City, Tenn. Sponsors: W. S. McNab, N. H. Grotelueschen.

George Dewey Brymer—Dyer, Knit Products Corp., Belmont, N. C. Sponsors: A. R. Thompson, Jr., W. A. Daniel.

David J. Burns—Proprietor, Dyer and Chemist, D. J. Burns & Co., Brunswick, Victoria, Australia.

William B. Carroll, Jr.—Foreman, Eagle & Phenix Mills, Columbus, Ga. Sponsors: E. A. Feimster, Jr., J. H. O'Neill.

Perrin Nicholson Collier—Vice-President and Staff Manager, Callaway Mills, LaGrange, Ga. Sponsors: R. W. Philip, C. A. Jones.

William U. Collier — Superintendent, Bristol Knitting Mills, Bristol, Va. Sponsors: Malcolm Mackenzie, W. S. McNab.

Walter Cooper—Supt. of Dyeing, Hanover Woolen Mills, Hanover, Ill. Sponsors: A. T. Brainerd, E. H. Roedel.

Thomas F. Daley—Foreman Dyer, Fall River Bleachery, Fall River, Mass. Sponsors: K. M. Grinnell, Frederick Mason.

William B. DePass—Overseer of Printing, Ware Shoals Bleachery, Ware Shoals, S. C. Sponsors: H. E. Kiefer, Jr., A. R. Thompson, Jr.

Gerald J. Desmond—Secretary, Jacques Wolf & Co., Passaic, N. J. Sponsors: C. J. Rahm, G. W. Apsey, Jr.

Walter J. Digrius—Salesman, American Laboratories, Inc., New Brunswick, N. J. Sponsors: A. O. Johnson, J. C. H. Dempsey.

George L. Dozier—Salesman, Sandoz Chemical Works, Inc., Marietta, Ga. Sponsors: F. P. Summers, A. R. Macormac.

Albert Graham Fisher, Jr.—Chief Chemist, North Carolina Finishing Co., Salisbury, N. C. Sponsors: W. L. Barker, A. R. Thompson, Jr.

William C. Fritz—Chemist, Mohn Bros. Co., Reading, Pa. Sponsors: H. E. Tillson, E. C. Hansen.

J. V. Galloway—Supt. of Dyeing, Vanette Hosiery Mills, Dallas, Texas. Sponsors: D. S. Culberson, L. B. MacFarland.

Herman Peter Gross—Plant Manager, Lincoln Rug Co., East Newark, N. J. Sponsors: E. E. Fickett, H. C. Chapin.

Elmer N. Grotjahn—Dyer, Strutwear Knitting Mills, Minneapolis, Minn. Sponsors: P. F. Willgeroth, C. E. Maher.

Arthur Edward Hatfield—Vice-President, Hatfield-Langley Corp., Boston, Mass.

Walker Cobb Hunter—Overseer of Piece Dyeing, Eagle & Phenix Mills, Columbus, Ga. Sponsors: E. A. Feimster, Jr., Adam Fisher, Jr.

Kendrick Hurley—Manager, Designing and Technical Dept., Southeastern Cottons, Inc., New York, N. Y. Sponsors: S. I. Parker, E. W. Pierce.

Glenn D. Jackson, Jr.—Finish and Fabric Development, U. S. Finishing Co., Sterling, Conn. Sponsors: L. H. Bailey, W. H. Hutchison.

Charles R. Johnson—Technical Asst., Bigelow Sanford Carpet Co., Thompsonville, Conn. Sponsors: Robert Houghton, G. E. Hopkins.

Allen Jones—Superintendent, Muscogee Mfg. Co., Columbus, Ga. Sponsors: R. W. Philip, S. I. Parker.

Fletcher Leon Kibler—Dyer, United Hosiery Mill, East Chattanooga, Tenn. Sponsors: W. S. McNab, F. F. Myers.

Clarence L. Krause—Foreman of Bleaching and Dyeing, Amazon Knitting Co., Muskegon, Mich. Sponsors: A. J. Feit, J. C. Moertel.

Edwin Foy Landis—Dyer, Ashe Hosiery Mills, Knoxville, Tenn. Sponsors: W. S. McNab, F. F. Myers.

E. Philip Lavoie—Dyer, Danvers Bleachery, Peabody, Mass. Sponsors: J. H. Brady, Wm. Beck.

John A. Levering—Treasurer, Eavenson & Levering Co., Camden, N. J. Sponsors: A. L. Smith, R. M. Ritter.

Edgar N. Livingston—Dyer, Strutwear Knitting Mills, Minneapolis, Minn. Sponsors: P. F. Willgeroth, C. E. Maher.

Carle W. Mason—Asst. Supt. of Charlotte Plant, American Cyanamid & Chemical Corp. Sponsors: C. H. Stone, W. W. Puckett.

Edward Wm. McClure—Dyer's Asst., International Braid Co., Providence, R. I. Sponsors: H. J. Daigneault, J. P. Vanslette.

Daniel R. McIver—President, Original Bradford Soap Works, Inc., West Warwick, R. I. Sponsors: R. E. Derby, J. J. McArdle.

James Stewart Mitchell — Bleachery Superintendent, Muscogee Mfg. Co., Columbus, Ga. Sponsors: L. L. Baker, E. A. Feimster, Jr.

Musco S. Moore—Overseer of Dyeing, Revolution Cotton Mills, Greensboro, N. C. Sponsors: R. H. Souther, J. W. Ivey.

Aubra L. Moses—Supt. of Dyeing, Classe Ribbon Works, Inc., Anniston, Ala. Sponsors: L. L. Baker, J. C. Robertson.

Robert H. Park—In Charge of Physics Laboratory, Calco Chemical Co., Bound Brook, N. J. Sponsors: J. F. Warner, F. C. Dexter.

John D. Quern—Southern Representative, Buffalo Electro-Chemical Co., Charlotte, N. C. Sponsors: H. G. Miller, L. W. Sherrill.

Frank P. Reilly—Dyer and Finisher, Van Raalte Co., Saratoga Springs, N. Y. Sponsors: A. J. Anderson, C. C. Knights.

John W. Robertson—Asst. Chemist, Artloom Corp., Philadelphia, Pa. Sponsors: A. E. Jones, Jr., Daniel McGowan.

Thomas Rostron—Chief Chemist and Demonstrator, Ciba Co., Ltd., Montreal, Canada. Sponsors: C. B. Fieldhouse, E. W. Pierce.

Alexander Roy—Boss Dyer, Collingbourne Mills, Inc., Elgin, Ill. Sponsors. A. T. Brainerd, J. G. Stott.

Alfred G. Scattergood, 2nd—Chemist, American Dyewood Co., Belleville, N. J. Sponsors: E. Lesser, H. R. Tisdale.

Howard E. Shearer—Asst. Research Associate, National Ass'n of Hosiery Mfrs., Washington, D. C. Sponsors: E. M. Schenke, R. T. Mease.

Robert S. Steele, Jr.—Dyer, Walker County Hosiery Mills, LaFayette, Ga. Sponsors, F. F. Myers, N. Groteluechen.

Albert R. Tucker—Philadelphia District Manager, du Pont Co., R. & H. Chem. Dept., Philadelphia, Pa. Sponsors: R. M. Ritter, J. P. Conaway.

Samuel J. Walker—Analyst, National Association of Dyers & Cleaners, Silver Spring, Md. Sponsors: E. E. Fickett, H. C. Chapin.

H. A. Webb—Demonstrator, General Dyestuff Corp., Columbus, Ga. Sponsors: E. A. Feimster, Jr., E. M. G. Schroder.

Carl F. Weiss—Textile Chemist, Gera Mills and New Jersey Worsted Spinning Co., Passaic, N. J. Sponsors: J. E. Meili, M. Goldemberg.

Harry White—Dyer, Seling Hosiery Mills, Inc., Nashville, Tenn. Sponsors: W. S. McNab, J. H. Callicott.

Charles B. Wood—Supt. of Dyeing, Kaufman Plush Mill, Roxborough, Pa. Sponsors: J. P. Conaway, H. S. Travis.

Junior

Edward Jones—Laboratory Asst., Georgetown Silk Co., Wilkes-Barre, Pa. Sponsor: B. L. Hathorne.

Henry H. Latham—Chemist, Charlotte Plant, American Cyanamid & Chemical Corp. Sponsors: C. H. Stone, W. W. Puckett.

Robert H. Mabry, Jr.—Dye Laboratory Chemist, Bibb Mfg. Co., Macon, Ga. Sponsors: A. R. Macormac, Curt Mueller.

John W. Ross—Technical Sales Division, Carbide & Carbon Chemicals Corp., Atlanta, Ga. Sponsors: C. A. Jones, R. W. Philip.

Walter H. Sites—Asst. Chemist, Sandoz Chemical Works, Philadelphia, Pa. Sponsors: L. A. Oechslin, N. MacNeill, Jr.

Associate

Lawrence R. Brumby—General Superintendent, Bibb Mfg. Co., Macon, Ga.

Louis R. Caplan—Salesman, Calgon, Inc., Baltimore, Md.

Ottilio T. D'Alessio—Dyer, Palisade Piece Dye Works, North Bergen, N. J.

Luther A. Dillon—Asst. Manager, Staley Starch Co., Atlanta, Ga. Sponsor: A. R. Macormac.

Birger Egeberg—Director of Research, International Silver Co., Meriden, Conn.

William P. Holt—Laboratory Manager and Research Director, Eagle & Phenix Mills, Columbus, Ga. Sponsors: E. A. Feimster, Jr., J. H. O'Neill.

Thomas Wm. Kethley—Drug Chemist, State of Georgia, Atlanta, Ga.

John F. Kirk—Salesman, General Chemical Co., Philadelphia, Pa.

Alan Leonard Kling—Research Chemist, Atlantic Research Associates, Newtonville, Mass.

Murrell A. Land—Sales Engineer, Westinghouse Electric & Mfg. Co., Atlanta, Ga.

Paul J. Luck—Salesman, Calco Chemical Co., Bound Brook, N. J. Sponsor: G. A. Moran.

John J. Morris—Cost Accountant, Norwich Knitting Co., Norwich, N. Y.

F. Faxon Ogden—Technical Sales Service, Monsanto Chemical Co., Merrimac Division, Boston, Mass.

F. Earl Schroeder—Salesman, Maher Color & Chemical Co., Chicago, Ill. Sponsors: P. F. Willgeroth, C. E. Maher.

William S. Sewell—Salesman, Scholler Bros., Philadelphia, Pa.

Clifford R. Smith—Salesman, Detergent Products Corp., Atlanta, Ga. Sponsor: F. O. Tilson.

J. Maxwell Sobin—Proprietor, Maxwell Chemical Co., Boston, Mass.

John N. Street—Library, Firestone Tire & Rubber Co., Akron, Ohio.

John C. Turner—Southern Sales Representative, Charles Bond Co., Atlanta, Ga.

Student

Henry M. Curry—New Bedford Textile School. Sponsor: F. E. Busby.

Nolan D. Helms—Alabama Polytechnic Institute. Sponsor: A. R. Macormac.

Vernon Clark Hill—Alabama Polytechnic Institute. Sponsor: A. R. Macormac.

Joseph J. Jigger—Alabama Polytechnic Institute. Sponsor: A. R. Macormac.

Charles W. McGowin—Alabama Polytechnic Institute. Sponsor: A. R. Macormac.

James H. Parechanian—Lowell Textile Institute. Sponsor: L. A. Olney.

Additional MEMBERSHIP APPLICATIONS

Active

Warren Chester Cobb—Salesman, Arnold Hoffman & Co., Huntsville, Ala. Sponsors: A. R. Macormac, Allen Jones.

Clyde H. Covington—Plant Manager, Neild Cleaners & Dyers, Baltimore, Md. Sponsor: E. M. Schenke.

Clarence Ferrell Gibson—Supt. of Dyeing, Amazon Cotton Mills, Thomasville, N. C. Sponsors: B. R. Harris, H. G. Miller.

Nevin A. Greenawalt—Dyer, Globe Bleach & Dye Works, Shoemakersville, Pa. Sponsors: H. E. Tillson, E. C. Hansen.

John C. Martin—Manager of Bleachery and Print Works, Ware Shoals Mfg. Co., Ware Shoals, S. C. Sponsor: H. E. Kiefer, Jr.

Russell Haynes McKinney—Salesman, American Cyanamid & Chemical Corp., Chattanooga, Tenn. Sponsors: W. S. McNab, G. W. Searell.

Turner Rollinson—Dyer, Jefferson Woolen Mills, Knoxville, Tenn. Sponsors: N. Grotelueschen, W. S. McNab.

William Sylvester Sims—Demonstrator, Geigy Co., Inc., Charlotte, N. C. Sponsors: H. G. Miller, L. W. Sherrill.

Bernard F. Smith—Laboratory Manager, Geigy Co., Inc., Charlotte, N. C. Sponsors: H. G. Miller, L. W. Sherrill.

Gordon F. Spencer—Overseer of Bleaching, Ware Shoals Mfg. Co., Ware Shoals, S. C. Sponsors: H. E. Kiefer, Jr., A. R. Thompson, Jr.

Junior

Howard P. Loveless, Jr.—Textile Chemist, Chickamauga Springs Bleachery, Chickamauga, Ga. Sponsors: R. S. Wheeler, J. D. Mosheim.

Associate

Paul Victor Keyser, Jr.—Division Supervisor, Socony Vacuum Oil Co., General Laboratories, Brooklyn, N. Y.

George M. DeCamp—Salesman, New England Lacquer Co., Providence, R. I.

Howard I. Belton—Salesman, American Aniline Products, Inc., Boston, Mass.

ONE HUNDRED AND SIXTEENTH COUNCIL MEETING

THE Council held its 116th meeting in the Providence Engineering Society Building in Providence, R. I., on Friday morning, February 11, 1938. Present were President Alban Eavenson, presiding; Duncan Ferguson, Vice-President; William R. Moorhouse, Treasurer; Louis A. Olney, Chairman of the Research Committee; William H. Cady, Robert E. Rose, and P. J. Wood, Past Presidents; Arthur E. Hirst, and Walter M. Scott, Councilors at Large; Ben Verity representing Rhode Island; R. M. Ritter and Herbert S. Travis representing Philadelphia; and Harold C. Chapin, Secretary. The Secretary's report of the 115th Council meeting, the Treasurer's report of February 10, and the Secretary's balance sheet attached hereto, were accepted.

A financial report from the Philadelphia Section on the Annual Meeting was accepted, and appreciation was voted to the Section for its hospitality and excellent program.

A tellers' report from E. E. Fickett, C. L. Howarth, and J. H. Skinkle was accepted, and the candidates named on the last annual ballot for officers of the Association were declared elected. A price of $1.50 each was set for the lapel buttons bearing the seal of the Association. A special design for Past Presidents' pins was approved.

Each of the following was elected to the class of membership specified, as of thirty days from publication of application, provided no objection be received meanwhile by the Secretary:

Active

Carl Altman	S. F. Donovan	W. H. McGuire
G. P. Andrew	R. H. Evans	E. F. Monroe
S. H. Antcliffe	W. B. Fish	Walter Mueller
L. B. Arnold, Jr.	C. B. Griffin, Jr.	J. R. Newell
G. O. Baker	F. C. Haas	H. A. Poovey
E. W. Birdsall	J. J. Haggerty	G. P. Rickards
A. D. Campbell	John Hulme	S. S. Rossander
H. F. Carmichael	W. H. Jackson	R. C. Roth
Tom Cheetham	E. W. Kaufmann	Edward Shumsey
George Cohen	E. H. Klipstein	P. S. Smith
T. J. Conway	F. L. Knecht	C. E. Stauffer
S. A. Dahlgren	O. P. Loescher	Mitchell Stead
Arne Delphin	L. P. London	Leo Stein
E. J. Diamond	H. Luttringhaus	J. A. Stinson
H. L. Dillard	P. E. McCarthy	G. A. Wright
W. F. Dolan	Henry McDonald	C. H. Young

Junior

C. A. Bergman	A. E. Giray	J. J. Roarke
Persis Bullard	I. I. Herzberg	C. E. Rollins
K. S. Campbell	C. J. Horne	P. L. Shurr
N. A. Cooke, Jr.	E. W. Kent	C. O. Stevenson
N. E. Daher	C. F. Lauer	E. M. Taylor
M. P. Decker, Jr.	J. E. Lepor	W. S. Truett
R. J. DeWitt	G. D. Marrocco	P. W. Volk
H. J. Dominici	C. P. McCann, Jr.	B. P. Wishnietsky
W. A. Drummond	J. F. Oliver	D. B. Woolley
W. J. Fritz		

Associate

A. J. Anderson	W. Hamilton	G. H. Small
E. H. Arnold	C. W. Hill	J. F. Smith
E. A. Barnett	A. Karasin	W. G. Smith
M. B. Bowman	G. O. Lines	C. G. Stover
H. S. Brightman	M. R. Pesce	P. G. Wear
E. B. Clancy	W. H. Randolph	D. R. Weedon
R. C. Cochrane	J. C. Reisinger	R. C. Weyer
J. H. Faunce	H. S. Schenker	J. G. Wick
G. E. Fleming		

Student

C. J. Dulin	H. S. Page	J. E. A. Schroder
S. G. Kaplan	A. Ramalho	

The following were transferred from other classifications to Active, F. H. Casey, E. J. Chornyei, S. M. Edelstein, J. C. Harris, J. L. Hart, E. C. Jackson, R. L. Matthews,

SECRETARY'S BALANCE SHEET—FEBRUARY 5, 1938

	Applications	*Dues, Regular and Reinstate.*	*Dues, Corporate and Sustaining*	*Miscellaneous*	*Bank Charges*	*Totals*
Received by Secretary, November 1 to 27, 1937	$207.50	$3,888.25	$1,960.00	$19.45		$6,075.20
Received by Secretary, November 27, 1937, to February 5, 1938	535.00	4,094.50	150.00	1,179.81*	—$1.80	5,957.51
Total received	742.50	7,982.75	2,110.00	1,199.26	— 1.80	12,032.71
Transmitted to Treasurer	742.50	7,784.75	2.110.00	1,199.26		11,836.51
Leaving to order of Secretary		198.00			— 1.80	196.20

MISCELLANEOUS ITEMS*			
Registrations, Annual Meeting	$832.00	Dyed Standards	3.00
Launder-Ometer royalties	32.00	Crockmeter cloth	6.00
Services, Treasury Dept.	115.00	Knitted tubing	36.01
Resale of used mercerizing machine	30.00	Year Books	124.80
Carbonizing Reports	1.00	Total	$1,179.81

J. J. McDonald, G. W. Schladensky, R. G. Schwarz, Jr., D. A. Siravo, W. F. Stifel, C. H. Stiteler, C. W. Thomas, J. J. Tomalino, F. V. Traut.

Respectfully submitted,

H. C. CHAPIN, *Secretary.*

ONE HUNDRED AND NINTH MEETING OF THE RESEARCH COMMITTEE

THE 109th meeting of the Research Committee followed the Council meeting in Providence on Friday afternoon, February 11, 1938. Present were Chairman Louis A. Olney, presiding, K. H. Barnard, W. H. Cady, R. F. Culver, W. C. Durfee, Alban Eavenson, Duncan Ferguson, A. E. Hirst, W. R. Moorhouse, R. M. Ritter, W. M. Scott, H. S. Travis, Ben Verity, P. J. Wood, and H. C. Chapin.

For the research program of the year beginning July 1, Alban Eavenson submitted a written program for his Committee on the Chemistry of Wool. William H. Cady, reporting for the Printing Paste Committee, stated that Dr. Gleysteen, in cooperation with Dr. Strachan and his students, is now working on both ageing and color values in printing. W. C. Durfee discussed the problem of measuring crocking from yarn. A letter from Hugh Christison again protested the term crocking as ambiguous. Mr. Cady reported briefly for the Light Fastness Committee, stating that standards would soon be ready for distribution. G. A. Moran, by letter, and the Chairman, reported on the progress of agreement with the British Society of Dyers and Colourists on washing fastness tests for cotton. A letter was received from J. F. X. Harold, requesting acceptance of his resignation as Chairman of the Committee on Waterproofness; and Professor E. R. Schwarz was appointed in his place. A letter from Walter D. Lowell suggested investigation of the effect of ultra-violet light in tendering of cotton, and Mr. Cady deeming this worthy of research by the Association, was appointed chairman of a committee to give it further consideration. Duncan Ferguson opened a discussion of the drastic nature of the Association's perspiration tests, in which it was stated that a less drastic alternative test is being developed by Professor Bertolet's committee.

Respectfully submitted,

H. C. CHAPIN, *Secretary.*

MEETING, SOUTH CENTRAL SECTION

AT a meeting of the South Central Section on January 22nd the following officers were elected:

Chairman, Nestor Grotelueschen.
Vice-Chairman, R. M. Covington.
Treasurer, C. C. Cayce.
Secretary, W. S. McNab.
Councilor, Homer Whelchel.
Sectional Committee, Walter Mobley, H. H. Morrison, G. W. Searell, D. A. Torrence.

A color film with sound attachment entitled, "The Rainbow of Chemistry," was shown by the Calco Chemical Co. Also shown was a slow motion film illustrating various golf strokes.

Respectfully submitted,

W. S. MCNAB, *Secretary.*

MEETING, PHILADELPHIA SECTION

THE regular meeting of the Philadelphia Section was held at the Penn Athletic Club on Friday, March 4, 1938. The topic for discussion was, "Textile Waste Disposal, An Orderly Approach to the Problem," prepared jointly by Mr. L. L. Hedgepeth, manager, and Mr. C. B. Griffin, Jr., of the Technical Service Section of the Pennsylvania Salt Manufacturing Company, in the form of a paper and presented by Mr. Hedgepeth.

Mr. Richard Clarkson of the Ford Motor Company, presented a sound motion picture entitled, "Ford; Men, Machines and Methods."

The usual informal dinner, at which 101 were present, preceded the meeting, while 125 attend the meeting.

Respectfully submitted,

P. L. SPEAKMAN, *Secretary.*

SPRING MEETING, SOUTH CENTRAL SECTION

THE Spring meeting of the South Central Section was held on Saturday, April 9th in the Andrew Johnson Hotel, Knoxville, Tennessee. At a meeting of the Sectional Committee in the afternoon it was decided that the Summer outing be at the Lookout Mountain Hotel, Chattanooga, Tennessee, the first or second week in August.

After the banquet new members were introduced and guests welcomed by the Chairman, Mr. Grotelueschen. On motion of Mr. Herbert Rodgers it was voted that the Secretary be requested to write the past Chairman, Mr. Walter Hadley, expressing regret because of his illness and consequent inability to attend the meeting. Mr. A. Beane was elected to represent the Section on the Committee to Nominate Officers for the Association. An invitation was extended by Mr. Robert Philip, Chairman of the Southeastern Section, for all members of the South Central Section who possibly could be present at the Fall meeting of the Southeastern Section to cooperate in making plans for the Annual Meeting to be held December 3rd and 4th in Atlanta, Georgia.

After the business meeting, Major F. W. Hyde of the United States Army gave a talk on the Orient; and Mr. Snapps of Atlanta showed a motion picture on Enduro Stainless Steel submitted by the Republic Steel Corporation.

Respectfully submitted,

W. S. MCNAB, *Secretary.*

Physical and Chemical Textile Testing

(Continued from page 238)

or the number of yarns broken, so that the same size specimen is not always necessary but results on any size of specimen may be compared with results on any other size. Work of rupture is not exactly proportional to the length of specimen but becomes so by subtracting a small constant amount, so here too another variable is eliminated.

On the other hand, it has been shown that ballistic tests are more sensitive to humidity variations; it has also been shown that yarns ranked by ballistic test results show serious differences from practical results; also, as stated before, the work of rupture may be measured on a stretch-load diagram if it is desired.

BURSTING STRENGTH MACHINES

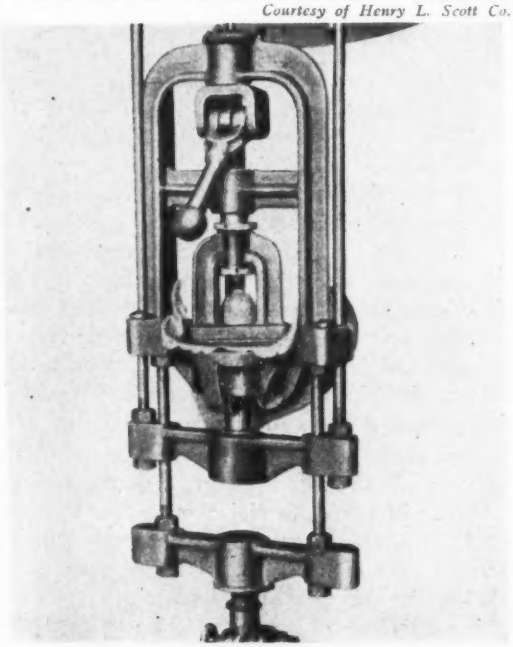
Bursting strength is used considerably in evaluating the strength of knit goods since strength tests are very hard to carry out; it has some use on woven fabrics which are to be stressed equally in all directions when in use, because it selects the weakest yarns (warp or filling) and breaks those, giving then the lowest pressure the cloth will withstand. Two methods of determining bursting strength are available:

1. Ball burst—special attachment for the strength tester.
2. Hydraulic burst—Mullen tester.

The ball burst attachment for the strength tester (Figure 48) consists of two stirrups which slide on each other; one stirrup, which replaces the top jaw, supports a post with a hard steel ball one inch in diameter held in a cup; the other stirrup, replacing the lower jaw, has two rings of 1.75 inches internal diameter between which the specimen (3 inches square) is clamped. On starting the machine, the fabric is pulled down against the ball until bursting occurs, the strength testing machine then indicates the bursting strength. Haven has shown that the ratio of the ball burst strength to the strip test strength in the weaker direction equals 4/3.

The Mullen tester (Figure 49) in its simplest form consists of a pump operated by a hand wheel which pumps oil or glycerine against a thin, flexible rubber diaphragm. Above the rubber diaphragm is the specimen, clamped between two rings of 1.2 inches inside diameter. A pressure gauge built on the ratchet principle records the maximum pressure when the specimen breaks. In use, the specimen is clamped in place and the hand wheel is turned at an even speed until rupture occurs; the number of turns of the hand wheel and the reading of the pressure gauge are then noted; this is repeated for all the specimens. To compensate for the pressure used in stretching the rubber diaphragm, the hand wheel is given the same number of turns with no specimen in place as was used with the specimen and the pressure read on the dial; this pressure subtracted from the pressure with the specimen gives the corrected bursting pressure. A newer modification of the Mullen tester has the pressure applied by a constant speed motor and the bulge of the diaphragm and specimen recorded by a tilting arm and recording pen; in this case, the correction for the diaphragm is obtained from a chart of diaphragm bulge against pressure made with no specimen in place.

Fig. 48—Ball-Burst Attachment for Strength Testing Machines
Courtesy of Henry L. Scott Co.



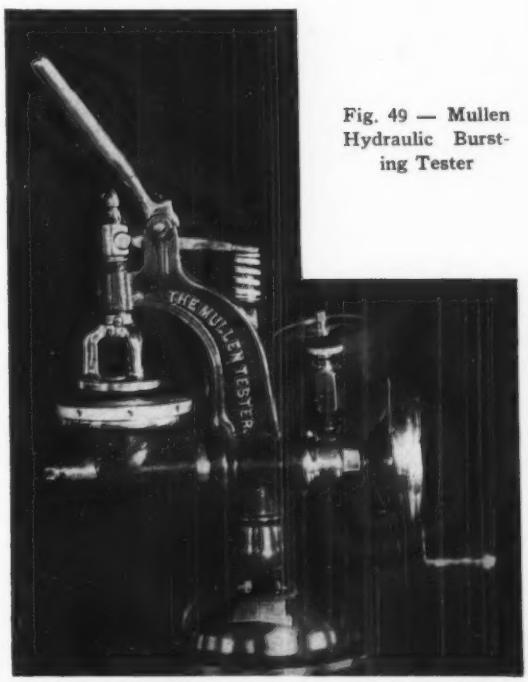


Fig. 49 — Mullen Hydraulic Bursting Tester

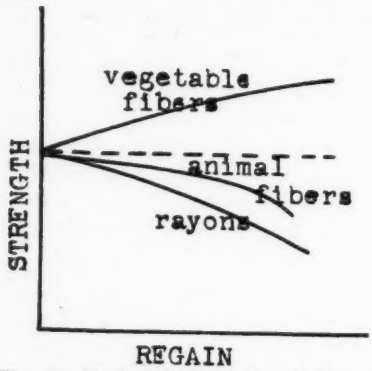


Fig. 50—Typical Strength-Regain Curves

In theory, both methods of bursting strength measurement suffer from the error of short lengths of fabric tested which may be less than the fiber length. In practice this is not important since only comparisons are needed and also because it is used chiefly on knitted goods where the actual length of yarn between the clamps is two or three times the inside diameter of the rings, due to the bending of the yarn in the knitted fabric.

EFFECT OF MOISTURE

The strength and stretch of all textiles is seriously affected by the regain present in the sample, which as we have seen in Chapter 2 is in turn affected primarily by the relative humidity of the air and to a small extent by the temperature. As generalizations we may say that the stretch of all textiles is increased with an increase in regain, and the strength of vegetable fibers is increased but the strength of animal fibers and the rayons is decreased by an increase in the regain; Figure 50 shows the general relationship of strength and regain. Since the regain has such an important effect on the results and since it is impracticable to test samples when oven-dry, one of the following methods must be resorted to in order to obtain results which are comparable with results obtained by another laboratory or with results obtained at any other time by the same laboratory:

1. Test wet.
2. Test at standard temperature and relative humidity.
3. Test at prevailing room conditions, determine the regain, and correct the results to standard regain.

Testing wet was once quite common but is now done only in the case of rayons where one of the most desirable properties is a comparatively small loss in strength on wetting; rayons therefore are tested both wet and dry. The rayon should be soaked in tap water at room temperature for two hours, put in the strength tester and tested within a minute. Results on a rayon yarn are given in grams per denier; if rayon cloth is tested (by the grab test) the number of yarns per inch in the dry state and in the wet state are counted and the wet strength is corrected to the same number of yarns as are present in the dry sample. If the stretch-load diagram of a wet rayon is obtained, it will be found that the elastic limit is missing (Figure 51). This explains the

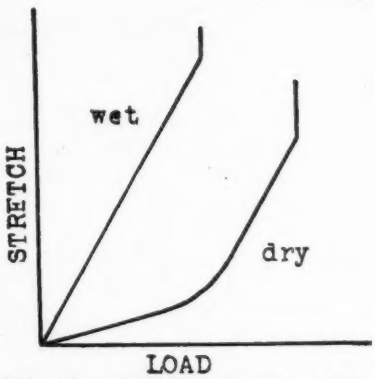


Fig. 51—Stretch-Load Diagrams for Wet and Dry Rayons

production of rayon "shiners" found when the rayon is stretched in the wet condition; on drying, the rayon remains stretched.

Testing at standard conditions of temperature and relative humidity (70° F. and 65 per cent relative humidity) requires a special testing room (see Chapter 2) but is the most accurate, most convenient, and quickest method of testing; if the volume of testing done warrants it, this method should be used.

If a conditioning room is not available we may test at whatever conditions prevail, obtain the amount of regain present in the broken specimens, and correct the strength to standard regain by fairly accurate formulae. The stretch of samples cannot be so corrected with any degree of accuracy. If the regain-strength curve of practically any yarn or fabric is drawn, it will be found that the middle portion of the curve, including the standard regain, is a straight line or a close approximation to a straight line, so that the equation of this straight line portion may be used to correct the strength from one regain to another. This equation may be given as:

$$S = M \times \frac{100 + rR}{100 + rA}$$

where S = strength of standard regain
M = strength from machine reading
R = standard regain
A = actual regain
r = rate of increase or decrease of the strength for 1 per cent change in regain, expressed as per cent of the dry strength.

"r" is independent of the form of the fabric or yarn and is dependent only on the weight of the fabric (or counts of the yarn) and the fiber of which it is composed. Values of "r" are given in Table XI and standard regains have previously been referred to (Table IV).

An example of the correction method of obtaining strength is as follows:—

A sample of cotton cloth of 4.25 ounces per square yarn is tested for breaking strength by the grab method and gives an average of 41.5 pounds on the warp and 33.8 pounds on the filling. After breaking, a specimen is placed in a weighing bottle (tare weight of 19.5560 grams)

TABLE XI

Strength Correction Factors

Fiber present	*Cloth weight oz./sq. yd.*	*Yarn count or denier*	*Strength correction factor*	*Authority*
Cotton	1½-4	above 20's	+5.2	Haven
Cotton	4-10	10's-20's	+6.0	Haven
Cotton	10-18	2's-10's	+7.7	Haven
Cotton	18-46	below 2's	+10.1	Haven
Cotton	—	all	+6.0	A.S.T.M.
Cotton tire fabric	17¼	—	+6.0	Haven
Cotton tire cord	—	3/5/23's	+6.9	Haven
Cotton tire cord	—	3/5/23's	+3.5*	A.S.T.M.
Cotton fabric (2-ply)	11	—	+16.5	Haven
Mercerized cotton	3-4½	—	+3.3	Haven
Mercerized cotton	—	above 20's	0.0	Haven and others
Linen	4½	—	+8.0	Haven
Ramie	9	—	+3.8	Haven
Jute	7½-15	—	+2.5	Haven
Wool serge	6.9	—	—1.7	Haven
Camel hair	—	4-ply	—1.4	Haven
Raw silk	3.0	—	—1.1	Haven
Silk	1.9	—	—1.3	Haven
Viscose	—	100d	—2.7	Haven
Viscose	—	150d	—2.6	Haven
Viscose	—	200d	—2.9	Haven
Viscose	—	300d	—2.7	Haven
Acetate	—	100d	—3.1	Haven
Acetate	—	150d	—4.1	Haven
Acetate	—	300d	—3.8	Haven

*Correction to standard regain of 6.5 per cent, correction applies only from 5.5 per cent to 7 per cent regain.

and weighed, the weight of bottle and sample being 21.9375 grams. On drying the sample in the oven, and weighing again, the dry weight is 21.8495 grams. What is the strength of the cloth at standard regain?

	gms.
Weight of bottle and sample	= 21.9375
Weight of bottle and dry sample	= 21.8495
Weight of moisture	0.0880
Weight of bottle and dry sample	= 21.8495
Weight of bottle alone	= 19.5560
Weight of dry sample	2.2935

Actual regain = A = 100x0.0880/2.2935 = 3.84%

Standard regain = R = 6.5% (Table IV)

Strength correction factor = r = 6.0 (Table XI)

Warp

$$S = 41.5 \times \frac{100 + 6.0 \times 6.5}{100 + 6.0 \times 3.84} = 41.5 \times \frac{100 + 39.0}{100 + 23.0} = 41.5 \times 139/123 = 46.9 \text{ pounds}$$

Filling

$$S = 33.8 \times \frac{100 + 6.0 \times 6.5}{100 + 6.0 \times 3.84} = 33.8 \times \frac{100 + 39.0}{100 + 23.0} = 33.8 \times 139/123 = 38.2 \text{ pounds}$$

The strength of the cloth, then, at standard regain is 46.9 pounds in the warp and 38.2 pounds in the filling.

OTHER DETERMINATIONS WITH STRENGTH TESTERS

Many light and open fabrics such as gauzes, nettings, or marquisettes depend upon the friction of the yarns to hold together unless an expensive leno weave is used. To test the friction of the yarns, ravelled strip samples may be prepared as usual, then the cross threads may be ravelled down to 3 inches. At one end of the remaining cloth, alternate yarns are cut off; at the other end the other yarns are cut; the sample is inserted in the strength tester and run as a strip sample. In this case the force to pull half the yarns longitudinally past the other half is measured.

Two tearing tests are described by the A.S.T.M. The simplest method (tongue method) uses specimens 3 inches wide and 8 inches long, five each of warp and filling. A cut 3 inches long is made lengthwise in each specimen, starting in the center of one short edge, the pawls of the ratchet are disengaged, the specimen is placed in the machine with one tongue in the top jaws and one in the lower jaws. The force to tear is read off the stretch-load chart since it requires averaging a rather jerky load reading. The other method (trapezoid method) uses specimens 3 inches wide and 6 inches long with the warp samples having the long dimension parallel with the filling. From these specimens, using a template, isosceles trapezoids of height 3 inches and bases 4 inches and 1 inch are cut out, and a cut ¼ to ⅜ inches long is made in the center of the one inch edge and perpendicular to it. Clamps 3

inches or more wide are used and a gauge length of one inch, the pawls are disengaged. The specimen is clamped in the machine along the non-parallel sides of the trapezoid so that the cut is halfway between the clamps, the short edge held taut and the long edge hanging in folds. The force to tear is read from the stretch-load chart as before.

The seam slippage of silk and rayon fabrics is another important determination; the determination made is the force across the seam per inch of width necessary to produce an elongation of ¼ inch in excess of the normal stretch of the fabric under the same load. A standard grab tester of 50 pounds capacity is used. Two specimens are cut out, one 4 inches by 10 inches, the other 4 by 4 inches; the smaller specimen is sewed to the longer by a standard seam ½ inch from the end, using a needle of approximately .030 inches diameter, No. 00 white mercerized cotton thread, 14 stitches to the inch, and a plain stitch. A stretch-load chart is made on the long strip; then, using the same chart, on the seam. With a pair of dividers, the difference in the two curves at one pound force is measured, the dividers are set for this distance plus ¼ inch and run along the curves until the force where the two curves are separated by this distance is found; this force minus the one pound is the resistance to slippage of the seam.

Felts may have two determinations made on them—breaking strength and splitting resistance. For breaking strength, specimens 2 inches wide and 10 inches long are used, jaws are 2 inches wide, gauge length is 3 inches, jaw speed is 12 ± ½ inches per minute. Results are given in pounds per 2-inch width. For splitting resistance the same machine, jaws, and specimen size are used. The specimen is split in thickness by a knife cut in the middle third of the thickness for 2 inches from one end, one lip is clamped in each jaw, and the force to pull the two sections wholly apart is measured. The splitting resistance is not determined on felts less than 3/16 inches thick.

REPEATED STRESS TESTS

As we have seen early in this chapter, textile materials are not ordinarily subjected to a single large load in actual use, but rather to a large number of fluctuations in load or a number of repeated small stresses; tire cords, for example, are continually being given stresses much smaller than their breaking strength and finally fail due to the accumulated effects of these numerous small stresses rather than to a single large one. It would be much more like actual conditions of use, then, to test the strength in this manner, and of late years much more attention has been given to tests of this sort. Some strength testing machines are now so built as to make it possible to automatically apply and remove a definite load for an infinite number of times.

The most significant way to measure this "fatigue" of textiles would be to find that load which the specimen would bear indefinitely (or for a fixed large number of applications) but this would be a slow and laborious task. Peirce has suggested the measurement of the number of applications of a load equal to 60 per cent of the break-load which would cause rupture of the specimen. Figure 52 shows the first two cycles of load applied to a cotton yarn where the load is brought to a certain value each time; further cycles do not differ very much from the second cycle, but it will be noted that the second cycle is distinctly different from the first.

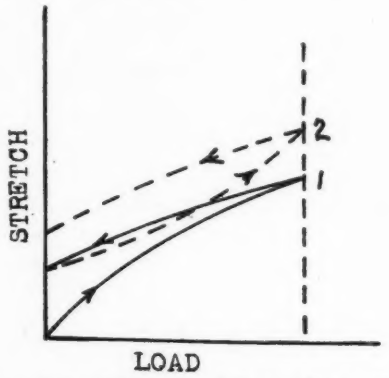


Fig. 52—Stretch-Load Diagram of Cotton Yarn with Repeated Stress Applications

At present, tests of this nature are still in the research stage and no standards of method or results have been set up as yet.

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This installment completes the section on Physical Testing. Further installments on Chemical Testing will be published during the summer months.

TECHNICAL NOTES FROM FOREIGN SOURCES

Degumming of Ramie

L. Pauley—TIBA 15, 151 (1937)—Ramie, although as a plant it is botanically much different from flax, presents about the same sort of problem in getting the fiber into a condition suitable for working up. It was originally treated in the same way as flax, by subjecting the stalks to the process of retting; but chemical treatment to liberate the fiber from its gums and other incrustations is now in favor.

The paper describes in detail the approved methods of preparation of the fiber by caustic alkalies, ammonia and sulfite, and trisodium phosphate, with many practical details and comments.

Testing of Dyeings as to Stability to Heat

Dr. Karl Schwertassek; Mell. Textil-Ber. 18, 373 (1937)—Methods for testing the fastness of dyeings toward heat under ordinary conditions are already a part of the praxis of fastness-testing, under the subdivision of hot-pressing or ironing. In the "Verfahren, Normen und Typen" of the German Fastness Commission, such tests are carefully prescribed, and consist in the hot-pressing of the dyeings, on cotton, wool, silk, rayon, and acetate silk, under very definitely limited conditions, partly in the moist, partly in the dry condition, and at temperatures ranging from, say, 100° to 200° C.—conditions likely to be encountered in normal methods of processing, or in the later working up of the weaves, or in the retailoring, cleansing, etc., of the goods worked up into garments, etc., and needing cleansing, pressing, etc.

The author, however, considers the case of other and unusual conditions being met with, accidentally or through special demands made upon goods which have satisfactorily passed the ordinary, standard requirements; such conditions, for example, as short heating at 250°-350° C. Such an extreme condition as this range of temperature is not of merely academic interest; the present paper is the result of work done upon a technical problem actually submitted to the author in his professional capacity in the Textile Research Bureau in Reichenberg.

The apparatus used (one diagrammatic sketch) is simple; a testtube of about 2.5 cm. diameter, whose lower end projects into a shaped depression in an asbestos-gauze, so that the lower part of the testtube can be heated in a Bunsen flame (not merely the center of the bottom of the testtube) is nearly filled (4/5) with thick lubricating oil, and clamped upon a retort-stand as usual, a thermometer (400° C.) dipping well down into the oil. The sample of goods to be tested is a narrow, sufficiently long strip of the material, which is first stretched between the fingers, and wound snugly about the outside of the testtube, at the level of the thermometer-bulb within, a short distance above the upper surface of the gauze (this preventing overheating of the sample by convection-currents from the flame). The temperature of the oil, above 250°, is raised slowly, to insure accuracy. The test lasts about 3-4 seconds, and is estimated by the aspect of the part of the sample which touches the hot wall of the testtube.

At a temperature of 270°, substantive colors show a decisive alteration (on cotton, linen, and rayon). Rayon, at this temperature and under the conditions specified, shows little change in breaking-strength.

Naphthol AS dyeings usually undergo change in hue at a higher temperature (about 335°-338°). At this point, however, the fiber begins to break down (tests made also upon undyed rayon as a check). The stability of the colors is frequently higher than that of the fiber.

Among the various situations in which such extreme heating may take place is that of the singeing process, and, in a later stage in the history of the goods, in carelessness in laundering in the household ("scorching" during careless ironing).

Absorption of Acids by Wool

Hans Joachim Henk—Mell. Textil-Ber. 18, 377 (1937)—It is well known that wool, when treated with an acid, absorbs a definite percentage of it as to its own weight, but in doing so is apparently not itself altered. A difference, however, between treated and untreated fiber is

plainly evident when the behavior of the two toward dyestuffs is considered. Wool treated with dilute acids is dyed by acid dyestuffs in neutral bath, while there is much less affinity for the basics dyestuffs. By continued treatment with boiling dilute acids, wool is completely altered and chemically broken down. There seems to be no regular relation between the degree of absorption and the degree of dissociation of the acid employed (a graph showing this fact is given, covering acetic, formic, hydrochloric, sulfuric, and oxalic acids).

As to degree of absorption of acids, the temperature does exert a powerful influence. Absorption diminishes with increase in temperature, for a given concentration of acid. The presence of another acid also alters the degree of absorption.

Dilute sulfuric acid cannot be absolutely removed from wool, even by prolonged washing to neutrality of the wash-water; but by treatment with dilute soda solution the residual acid can be neutralized, so that the wool will react toward dyestuffs in the same way as before acid treatment. But there is certainly more involved than mere absorption of acid by the wool; chemical reaction also takes place, as is shown by the presence of ammonium sulfate in the fiber after treatment with dilute sulfuric acid and thorough washing. The absorption of dilute acids is increased by the presence of hydrochloric acid, while the absorption of concentrated sulfuric acid is depressed. Hydrochloric acid alone behaves toward wool, as does sulfuric acid, but it can be removed by washing far more easily than can sulfuric acid. The presence of sulfuric acid depresses the absorption of hydrochloric acid, and its action is not influenced by the degree of concentration, as in the previous case. Chromic acid also is absorbed by wool, a fact underlying the effect of pre-chroming. Nitric acid shows a behavior differing from that of all other acids, in that it gives with the wool the xanthoprotein reaction, even at ordinary temperatures and in dilute condition. This yellowing of the fiber fails to take place only at concentrations below 2.7° B., and so nitric acid of this or lower concentration can be used for the preparation of a fiber of the desired properties so imparted. With nitric acid of a lower concentration, wool assumes a rough feel, and is no longer hygroscopic, and possesses an increased affinity for basic dyestuffs. Nitrous acid, of course, "diazotizes" wool, so that various color-tones can be obtained by after-treatment with phenols in alkaline solution. The acid number of wool treated with nitrous acid is about doubled.

By continued action of concentrated mineral acid, wool is completely broken down and chemically degraded. A short treatment with concentrated sulfuric acid does no harm to the fiber, but principally brings about an increase in the affinity of the wool toward basic dyestuffs, while acid dyestuffs are no longer taken up. This procedure does not possess any technical importance, since, on washing the wool so treated, even by gradual diminution of the concentration of the acid, by the use of successive baths of gradually lower sulfuric acid concentrations, some evolution of heat of dilution does take place, which brings about a chemical degradation of the fiber.

Organic acids are also absorbed by wool, and have the same effect upon the dyeing properties of the wool as do mineral acids. Acetic and other strong organic acids have, indeed, to be added directly to the dye bath, to diminish the affinity of the wool for basic dyestuffs, and so to increase that of the acid dyestuffs. Resorcylic and citric acids, at a high concentration, are able to destroy wool completely. Gallic acid, however, also a poly-hydroxy-carbonic acid, has not the same action; it is hardly absorbed by wool. Tannin is absorbed only from a boiling bath, and can be fixed upon the fiber by metallic salts. The wool is thus to a certain extent "immunized"; it possesses an increased affinity for basic dyestuffs, while, with a number of acid colors, it can no longer be dyed at all.

Enzymes and Diastases

N. Bourguignon—TIBA 15, 85 (1937)—A continuation of an interesting paper, this section containing much definite information.

In the first part of this section, entitled "Velocity of Enzymatic Reactions," a number of interesting facts is summarized. The velocity of reaction is governed at every instant by the enzyme-substratum concentration existing in the system. It has been observed that, after coagulation of an enzymatic solution, the activity of the solution is considerably increased, because of the increase in surface-area of the colloids present, there being also noted a simultaneous change in the sensitivity of the enzyme toward intermediate or final products formed by its action. If enzymatic solutions which behave as lyophilous colloids, after or without being frozen, or if the cellules, containing the enzymes themselves, are brought into contact with compounds which are easily absorbed by them, the reactivity of the enzymes is preserved for a much longer period, and the harmful influence of intermediate or final products of reaction is inhibited; the substances mentioned, which do not themselves take part in the reaction, bringing about an increase in the permeability of the membranes of the cellules; they form an adsorptive layer upon the active enzymatic surface, which is made evident by an acceleration of the reaction, and by a protective influence, upon the active surface, against the harmful action of the intermediate and final products of reaction. By such a stratification of the components, so to speak, the zymases are preserved to be employed in a later stage of the total process. Nord has well worked out these relationships. The mode of operation consists, briefly, in bringing into this sort of contact the cell-system or suspension of enzymes, and suitable compounds easily absorbable (butylene, acetylene, etc.), and then proceeding as in the older, simpler manner.

These experiments—rather, these determinations of the course of reaction—are described, and each series illustrated by a graph. The experiments consisted (a) in mixing a sample of dry brewer's yeast, for low fermenta-

tion, with water saturated with CO_2, allowing to macerate at 25° C., mechanically stirred (at this point such a suspension retained its activity for some weeks when kept at —10°), and treated for several minutes with a moderate current of ethylene gas. After standing in a cool place over night, it was (20 ccs.) treated with one gram of glucose, and the volume of CO_2 evolved at 30° was determined. A check experiment was carried out with a sample of yeast not so treated.—The experiment was continued by adding a second gram of glucose when the first reaction slowed down (evolution of CO_2), and at the same point thereafter successive portions of ½ gram of glucose were added. The graph shows strikingly the accentuation of effect by the given treatment of the zymase—speed of reaction, and total effect.

A second experiment was made in a similar manner, using brewer's yeast for high fermentation. The results of this experiment are given in the second graph. A third experiment also was carried out with a zymase solution prepared as before, but in this case freshly distilled pyroracemic acid was added, and finally one gram of glucose. The three graphs show reactions of similar nature.

The second part of the paper deals with recent work upon proteolytic diastases. Bergman has done much work upon this aspect of the subject. No experimental work is here described, but reference is made to Bergmann's papers. The discussion is highly theoretical, but the facts cited will have a profound influence upon our grasp of the problems involved, in purely biological work, and as well in the study of the behavior of the animal textile fibers.

The third section deals with the methods of analysis of enzymatic and diastatic preparations; Wohlgemuth's method, and that of Chase and Donaldson (published in the Textile Colorist in 1925), are described carefully and fully.

The last section of the paper (which closes the whole) deals with the practical use of enzymes and diastases in the degreasing of textile fibers, and well summarizes the means of the sort which are at present available.

BOOK REVIEWS

A Comprehensive Treatise on Inorganic and Theoretical Chemistry *by J. W. Mellor, D.Sc., F.R.S. Published by Longmans, Green and Co., Ltd. 811 pages. Price* $20.00.

The sixteenth and final volume of this Inorganic Chemistry has just been published. The sixteen volumes taken together comprise the most complete reference work on Inorganic Chemistry that has ever been published. The first volume was published as early as 1922 and the succeeding volumes have appeared as rapidly as they could be prepared in keeping with the accuracy and completeness which have been maintained at a high standard. So long a time has lapsed since the original volume that it has been decided to prepare two supplementary volumes which will include the results of the most recent research and bring the whole series up to date.

Furthermore, there is such an ill defined borderline between Organic and Inorganic Chemistry, particularly in connection with some of the carbon compounds of hydrogen and nitrogen that it has been decided to prepare an additional special volume dealing with these borderline compounds.

The completeness of this work is indicated by the fact that of this particular volume, 417 pages are devoted to the element platinum and its compounds alone.

This volume also contains a very complete general index of the whole series.

The library of every educational institution with a chemical laboratory, or any other organization doing research work, should have this set of books for reference.

Textile Testing *by James Lomax, Longmans, Green & Co., London, New York, Toronto.* 5¼ *x* 8 *inches.* $3.00. 159 *pages of text,* 8 *pages of tables,* 42 *illustrations.*

The author states in the preface that this book is intended as "a text book covering the elements of this subject" and it fulfills its purpose excellently. The subjects covered are presented in a very digestable manner and at not too great length, as is proper in a textbook which presumably is to be supplemented by outside reading and laboratory practice.

A series of excellent photomicrographs (erroneously referred to by the author as "microphotographs") are given, although the author very properly warns against their exclusive use in identifying fibers. The chemical tests for fiber identification are the customary ones which depend upon the microscope for final positive identification.

The author emphasizes the desirability of proper sampling technique; and, recognizing the fact that most laboratory weighings are made in the metric system, gives his formulae accordingly. A good elementary discussion of units and calculations is given, also a discussion of statistical methods. The use of sub- and super-means is not very general today and standard deviation and standard error are much more used than this section might indicate. For a text giving such a presentation of data-and-results analyses, the author is rather lax in his abuse of significant figures. Some of the sample calculations are, according to American usage, unnecessarily complex.

Some more specific faults in the reviewer's opinion are:—

Scour loss of woolen and worsted yarns is mentioned without any warning as to the hydrolysis and absorption of soap.

Fastness to light section has no reference to artificial light sources.

The antique scale-interlocking theory of felting is given instead of the more modern fiber-travel theory.

Very few references to the literature are given.

The impression is given that cellulose fluidity tests are very simple. This may be true of the test itself in a

laboratory using it every day but when one considers the preparation of the reagent and the solution of the cellulose, one is disposed to think otherwise.

The author adds together the weights of duplicate samples and carries out the calculation as one large sample rather than carrying through each determination and comparing the results for checks. This practice of the author's completely does away with the value of check determinations.

The chemical tests are not presented as well or as thoroughly as the physical tests.

English practice is given throughout, this differs materially from American methods in detail, although the general principles are the same. In cases where the American methods are superior, no mention is made of them.

The sequence of the tests is not as logical as it might be.

In spite of the above, and considering the book as a text book rather than a reference book, it is the best text to appear yet in the English language; not ideal by any means, but a distinct step in the right direction. It is well written in clear and simple language which makes it valuable for self-study as well as for class use.

John H. Skinkle

TRADE NOTES • NEW PRODUCTS

• QUARTERLY PRICE LIST

The Quarterly Price List, issued by the R & H Chemicals Dept., E. I. du Pont de Nemours & Co., Inc., for April, 1938, has recently been distributed. Copies are available upon request.

• CIBA REVIEW

Ciba Review, Number 8, has recently been distributed. Featured in this issue is the subject: "The Dressing of Hides in the Stone Age" and articles which carry out the theme are: Prehistoric Chronology; The Tools of Man in the Stone Age; Hunting in the Stone Age; Art and Religion in the Early Stone Age; Leather Dressing in the Stone Age; The Clothing of Man in the Stone Age; Historical Gleanings; Scientific Notes.

Also included with this issue is a supplement entitled: "Dischargeable Shades on Natural Silk with Chlorantine Fast Colors." It is stated herein that it has been shown that dyeing natural silk in a neutral dye bath not only gives the most level results but preserves the quality of the material and therefore neutral dyeing products of all classes of dyestuffs are being preferred more and more in silk dyeing. For discharge style prints, for which a large proportion of the dyed pieces is intended, it is stated that the color should be dischargeable even in deep shades and of good fastness to light and water as printed silk goods are mostly for outerwear and decorative fabrics. These additional demands further restrict the choice of suitable products and, it is claimed, makes the patterns of Chlorantine Fast Colors very interesting in this connection.

Copies of *Ciba Review* are available upon request to the Ciba Company, Inc., Greenwich and Morton Sts., New York City.

• WISHNICK HEADS CAMPAIGN

Robert I. Wishnick of Wishnick-Tempeer, Inc., has accepted the chairmanship of the combined drive in the Chemical, Paint and Oil Division for the American Jewish Joint Distribution Committee and the United Palestine Appeal. Announcement of this fact was made at an organization meeting in the Chemists Club, 52 East 41st Street, at which time a quota of $30,000 was set.

Associated with Mr. Wishnick are: David A. Ansbacher; Abraham Chaleff, Chal-Bro, Inc.; Ralph Hart, Hart Products Corp.; Harry R. Hillman, Eagle Paint & Varnish Works; Aaron C. Horn, A. C. Horn Co.; Abraham E. Horn, A. C. Horn Co.; Albert M. Kahn, Consolidated Products Co.; David H. Litter, D. H. Litter Co.; Michael J. Merkin, Michael Merkin Paint Co., Inc.; Max Pick, L. Sonneborn Sons; Louis A. Rosett; Dudley D. Sherman, National Chemical and Mfg. Co.; Israel Silberman, Paragon Paint Co.; Dr. Ferdinand Sonneborn, L. Sonneborn Sons, Inc.; Rudolf G. Sonneborn, L. Sonneborn Sons, Inc.; Dr. Maximilian Toch, Toch Brothers, Inc.; and Herman Yablick.

• MEDAL, A.I.C.

The medal of the American Institute of Chemists, presented annually for outstanding service to the science of chemistry or the profession of chemist in America, has been awarded this year to Dr. Frederick G. Cottrell, consulting chemist, metallurgist, and inventor, for his outstanding scientific achievements and for his service to the profession through the support of research, according to an announcement made by President Maximilian Toch.

Dr. Cottrell's scientific work has been in the general field of physical chemistry, electrostatic separation of suspensions, and cryogenic separations of gases.

The medal will be presented to Dr. Cottrell at the annual dinner of the American Institute of Chemists, which will be held at the Claridge Hotel, Atlantic City, New Jersey, on May 14, 1938.

• STANDARD METHODS AND PROCEDURES

On Wednesday, April 16, representatives of ten national organizations met at the offices of the American Standards Association to set up standard methods and procedures for the guidance of testing laboratories and other public endorsement agencies.

Need for this action arises from the increasing use by producers and distributors of "approvals," "certifications" and "listings" to satisfy the consumer demand for more factual information concerning quality of goods and performance of equipment offered for sale. These "certifications" are of great potential value to the buying public if backed by adequate tests of responsible agencies; but, according to the Association of Consulting Chemists and Chemical Engineers who proposed that the American Standards Association undertake this work, such tests are not always carried out. "Irresponsible endorsements that claim significance which they do not possess," according to the Consulting Chemists and Chemical Engineers, are bringing the whole system into disrepute. Some vendors, the Association points out, cater to the consumer desire for facts by "asserting half-truths or by implications which have no real significance. In other cases there is no evidence of the existence of standards, and if they do exist they are not available to the public. Some vendors use 'certified' as a trade designation."

The proposal of the testing engineers and chemists, many of whom are heads of laboratories, has been heartily endorsed by the National Bureau of Standards; the

National Association of Purchasing Agents; the American Home Economics Association, the Consumers' Division of the U. S. Department of Labor, and the American Society for Testing Materials.

The plan is to set up standard practices covering fundamentals which should underlie approval procedures—such standards to be developed cooperatively by consumers, producers, distributors, and advertisers, many of whom were represented at the meeting.

Among the points suggested for inclusion are: a clear statement of the auspices under which any plan of approval is operated; adequate independent sampling and testing of the product to determine its conformity with definite, published standards; systematic re-examination to insure continuing conformity; records of tests to be publicly available; and compliance with these principles to be indicated on labels or tags.

At the meeting, Thomas A. Wright of the Association of Consulting Chemists and Chemical Engineers was appointed chairman and B. L. Oser secretary.

The following organizations were represented at the meeting: American Society for Testing Materials; American Home Economics Association; American Council of Commercial Laboratories; National Association of Purchasing Agents; Consumers' Project, U. S. Department of Labor; National Bureau of Standards; Association of Consulting Chemists and Chemical Engineers; National Electrical Manufacturers Association; National Retail Dry Goods Association, and National Federation of Textiles.

● A.A.T.T. MEETING

The last meeting of the American Association of Textile Technologists was held at the Architectural League Club Rooms, New York City, on the evening of April 6th, and was presided over by the President, J. F. X. Harold, Ph.D. Sixty-six members and guests attended the dinner and lecture which followed. The new members voted into membership at the meeting are John Steiger of Duplan Silk Corp., Alexis Sommaripa of E. I. du Pont de Nemours & Co., Inc., and E. L. Whitford of Chopak Textile Co.

The speaker of the evening was Mr. Constant Scholer, Textile Technologist and Director of the Association. The topic of his discussion was "The Technique of Making Jacquard Fabrics." He illustrated his remarks with line drawings showing (1) how to set up a plain loom harness, (2) several harness ties, (3) how striped jacquards are controlled, (4) casting out, (5) compound tie-up, (6) making of a square paper design, (7) method of reading designs, etc.

He also showed many samples of jacquard fabrics, many of them rare and intricate. He talked at length on how to judge a defect in a jacquard sketch. He described how to enter the warp in several types of harness.

The speaker for the next meeting, to be held at the same place on the evening of May 4th, will be Mr. Alexis Sommaripa, Manager of Fabric Development for E. I. du Pont de Nemours & Co., Inc., who will discuss the subject of rayon.

● SULFAMIC ACID

Commercial production of sulfamic acid, a new inorganic acid having the form of a crystalline solid was announced on April 20th by Martin E. Cupery, research chemist of E. I. du Pont de Nemours & Company, before the 95th meeting of the American Chemical Society convened at Dallas, Texas. This new acid is said to be colorless, odorless, non-hygroscopic, and non-volatile. It is stated that it can be shipped and handled with all the convenience of a solid, yet when dissolved in water it has the characteristics of a strong, highly-ionized acid, approaching hydrochloric and sulfuric acids.

Although identified about 60 years ago, sulfamic acid has never before been produced on a commercial scale because of lack of a practical process of manufacture. The new process, which was discovered independently at the same time in Germany and in the United States, and which is covered by patents here and abroad, is based on urea and fuming sulfuric acid. Although prepared from the organic compound urea, sulfamic acid itself is inorganic. In this respect, and because of much greater strength, it differs from such acids as lactic, acetic, formic, tartaric, and oxalic, to which group it is expected to be an important addition on the chemical market.

The original synthesis of the compound urea, which is employed in this new process, was a significant milestone in chemical progress. In 1828 the German chemist Wohler discovered that urea, once thought to be only of animal origin, could be made from ammonium sulfate and potassium cyanate, chemicals of the mineral kingdom. This discovery bridged the gap between "organic" and "inorganic" compounds, destroying the old idea of "vital force" as a factor in chemistry, and laying the foundation for modern chemical synthesis. The cycle is reversed in the present development, which converts urea (now produced synthetically in large quantities from ammonia and carbon dioxide) back into the inorganic realm to form a new inorganic compound for use by the industrial chemist.

Because of unique physical and chemical properties, sulfamic acid and its derivatives are expected to be instrumental in improving processes and reducing costs in a number of industries. For example, one potential use of the acid, which is now being evaluated by the dye and pigment industries, is for removing excess nitrites following diazotization reactions.

Salts formed by sulfamic acid with metals, including lead, barium, and calcium, are water soluble. The organic amine salts of sulfamic acid, such as quinine sulfamate, are considerably more soluble than corresponding salts of sulfuric and hydrochloric acids. These properties, Dr. Cupery said, are a significant factor in a number of possible commercial applications.

Dr. Cupery disclosed that ammonium sulfamate, a derivative of sulfamic acid, is the fire retardant announced by the du Pont Company last year. Ammonium sulfamate is unique among flameproofing salts because it does not cause stiffening nor otherwise adversely affect the handle and feel of fabrics and paper, and because it shows no tendency to effloresce to the surface upon prolonged storage. Furthermore, the fact that ammonium sulfamate shows less tendency than other inorganic salts to coagulate colloidal solutions indicates the possibility of flameproofing materials which have previously resisted treatment.

Other derivatives and reactions of sulfamic acid are of probable importance in the dye, pigment, textile, laundry, tanning, wood preserving, and petroleum industries.

● QUAKER SALES

Quaker Chemical Products Corp., Conshohocken, Pa., announces that the Wittichen Chemical Company, Division of Wittichen Transfer and Warehouse Company, 831 North Nineteenth St., Birmingham, Alabama, is now representing them in the leather, textile, paper and metal trade throughout the states of Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, western Florida, northwestern Georgia and western Tennessee. The Wittichen Chemical Company is now distributor for the Solvay Sales Corp., Ansul Chemical Company and the Barrett Company. Mr. James A. Brittain is in charge of this department and will service accounts interested in Quaker products.

George F. Ecker, formerly with National Oil Products Company has joined the sales department of Quaker. He has spent many years in the silk and allied industries in various sales and managerial capacities. Mr. Ecker will specialize in the development and sale of special silk oils and bases as well as rayon oils and bases for those industries and along with his work will be actively in charge of

mills in Pennsylvania, southern Jersey and Delaware territory to give them technical service.

• HERCULES OFFICERS

R. H. Dunham, president, Hercules Powder Company, after the annual organization meeting of the Board of Directors on March 23rd, announced the election of the following officers and members of committees for the ensuing year:

R. H. Dunham, president; C. A. Higgins, vice-president; T. W. Bacchus, vice-president; C. D. Prickett, vice-president; G. G. Rheuby, vice-president; L. N. Bent, vice-president; C. A. Bigelow, vice-president; C. C. Hoopes, treasurer; H. F. Smith, secretary; E. B. Morrow, assistant treasurer; R. N. McAdams, assistant secretary and assistant treasurer.

Executive Committee: R. H. Dunham, chairman; L. N. Bent, C. A. Higgins, G. G. Rheuby, C. A. Bigelow, C. C. Hoopes.

Finance Committee: C. A. Higgins, chairman; R. H. Dunham, G. G. Rheuby, G. M. Norman, C. C. Hoopes, C. D. Prickett, E. B. Morrow.

• SAFETY DEVICES

Willson Products, Inc., of Reading, Pa., have just issued a new catalog of industrial safety devices. This firm, which was established in 1870, is said to have been the first company in the world to specialize in the manufacture of safety devices for the protection of industrial workers.

The catalog, which is well illustrated, covers the complete Willson line of eye, nose, throat and lung protectors. Included are more than fifty types of goggles for every conceivable purpose, a dozen welding handshields and helmets, seven United States Bureau of Mines approved types of dust respirators, air line respirators, abrasive helmets, etc.

Copies may be obtained gratis by writing Willson Products, Inc., 305 Thorn St., Reading, Pa.

• NEW CHARLOTTE WAREHOUSE

Recognition of the growing importance of the South as an outlet for industrial products is made in the recent announcement by E. F. Houghton & Company of the opening of a new warehouse in Charlotte, N. C., located at 1301-05 W. Morehead St.

This company, which manufactures oils, leathers and metal working products, has long maintained a District Sales Office for the South in Charlotte for service in connection with textile processing oils, textile leathers, lubricants and leather belting.

The new warehouse property is on the main highway to the South and is served by a railroad siding. Two floors will be devoted to the stocking of products for more immediate service than can be given even by 36-hour delivery from the Main Plant in Philadelphia.

The Charlotte Warehouse and Office is under the direction of Mr. W. H. Brinkley, Southern Divisional Sales Manager, with whom are associated the following representatives:

Baltimore, Washington and Virginia—Walter Andrews, C. L. Elgert; North Carolina—S. P. Schwoyer; South Carolina—D. O. Wylie; Tennessee—V. C. Shadden; Georgia and Florida—J. J. Reilly; Louisiana and Mississippi—Byron E. Dodd; Texas—J. W. Byrnes; Oklahoma—G. J. Reese.

The Textile Research Department in Philadelphia which serves the industry on such features as the Size-Check-Up Tests, silk soaking tests, wetting-out agents and dye bath assistants, wool oils and finishing oils, includes in its personnel, Mr. C. B. Kinney, Manager, Mr. H. C. Roberts, Dr. J. H. Eaton, Mr. H. H. Kirkpatrick, Mr. George LeCompte.

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Finishing plant chemist desires responsible position. Expert on vats, napthols and other cotton and rayon dyeing. All types of control work and testing. 26 years' experience on yarn and piece goods. Write Box No. 993, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Plant-chemist, technician, desires position with progressive Finishing Plant. Experienced in processing of rayon, acetate, cotton piece-goods; can take complete charge of processing of Lastex Swimsuitings and Corset goods, can supervise laboratory control and research, economy in dyeing and finishing. References. Write Box No. 118, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED in dyeing and finishing plant. 15 years' experience in largest dyeing plants of the U. S. Expert cost system, production efficiency throughout every department, B. point, y.p. Man Hr., high qualities of synthetics, specialist—Romain, Sheer, Alapaca, etc., mill layout, revampings. Familiar with every type of machinery used Age, 38, can go to any state, South America, or Canada. Write Box No. 119, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: An expert dyer who would be capable of going into a small dye house handling direct, vat, naphthol, sulfur and diazotized and developed colors on cotton and rayon piece goods, for the purpose of advising the management as to how present methods and equipment can be improved and modernized. A thorough knowledge as to how goods should be prepared for dyeing essential. Plant located in the South. Position temporary. Dyer not employed at present preferred. Write Box No. 120, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Experience—17 years' experience textile field with two concerns. Charge of dye testing and matching laboratory on cotton, rayon, pure dye, tin weight, acetate and some wool, both plain and discharge dyeing, also printing experience. Plant experience—dyer on jigs and beck, rayon, acetate and silk. References. Education — evening Textile school, dyeing and some chemistry. Write Box No. 121, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.